THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LX. No. 1533.] LONDON, SEPTEMBER 27, 1892. [44TH YEAR. PRICE 6d.

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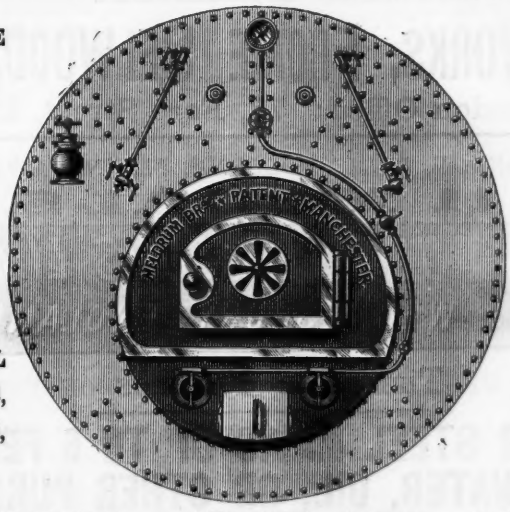

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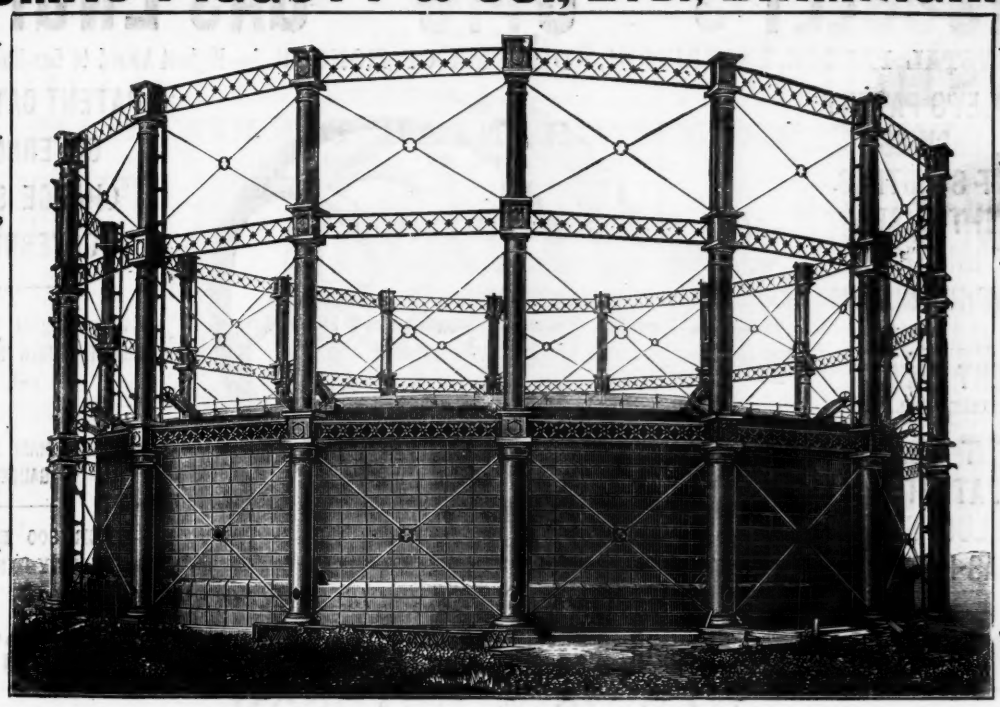

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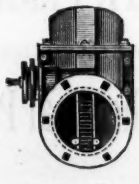

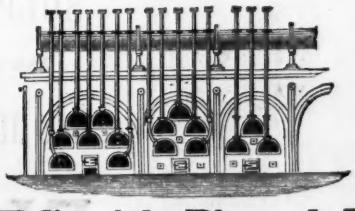

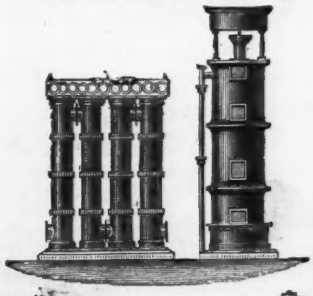

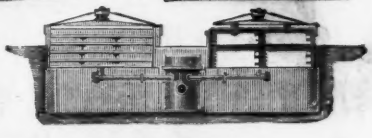

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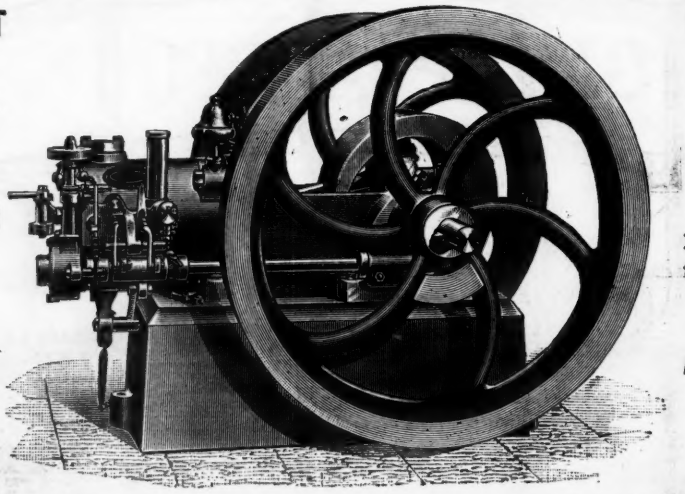

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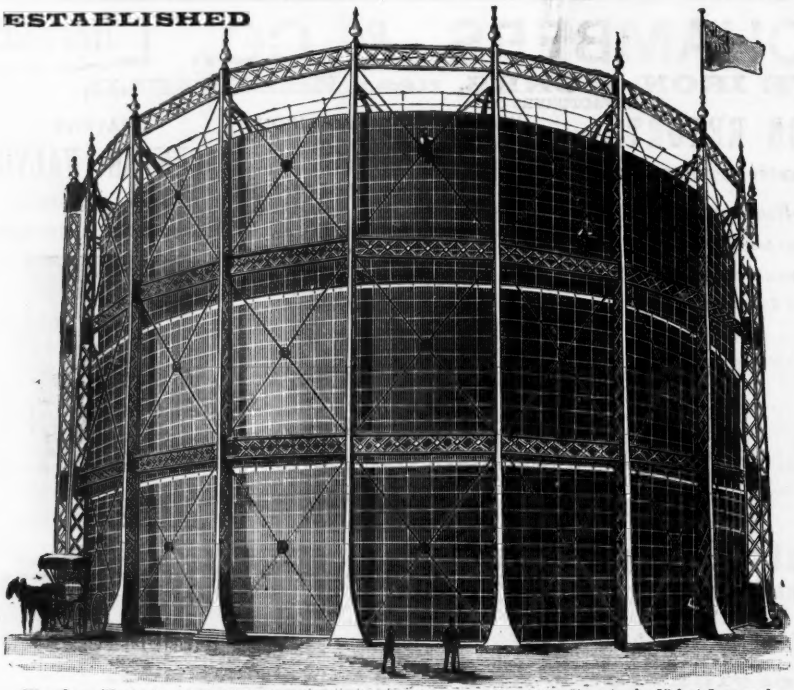

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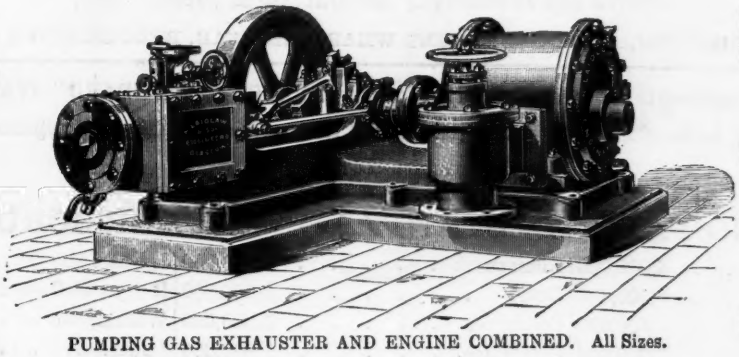

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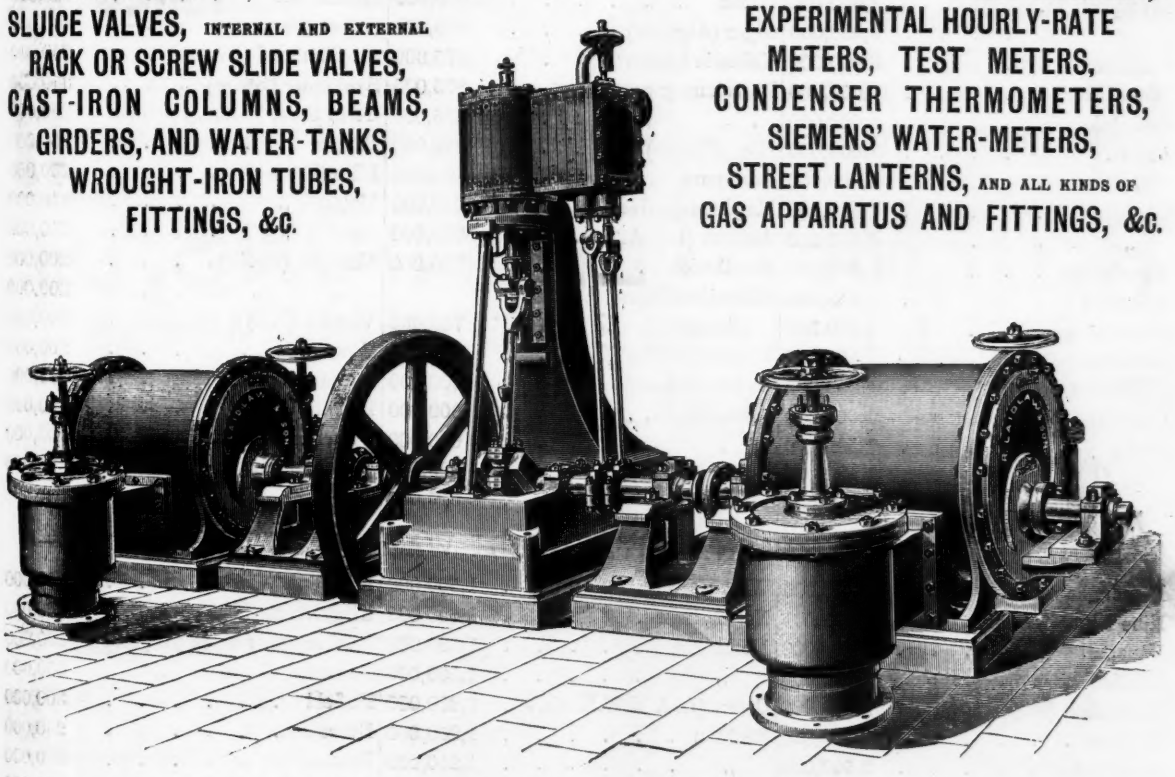

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WEIGHT IN MOTION, AND CONSEQUENT WEAR AND TEAR, REDUCED TO A MINIMUM.

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,,	3,500,000	Colchester	1,000,000	Workington	500,000
Kensal Green	3,000,000	Cambridge	1,000,000	Lowestoft	500,000
,,	3,000,000	West Bromwich	1,000,000	Newton-le-Willows	500,000
Liverpool	3,000,000	Luton	1,000,000	Manchester	400,000
,,	3,000,000	Alger (Algieria)	875,000	Erfurt (Germany)	400,000
Croydon	3,000,000	Valencia (Spain)	875,000	St. Chamond (France)	350,000
West Ham	3,000,000	Barcelona (Spain)	875,000	Santander (Spain)	350,000
Rochdale	3,000,000	,, ,,	875,000	Atlas Steel Works, Sheffield	250,000
Paris	3,000,000	Nice (France)	875,000	Bangor	250,000
,,	3,000,000	Stockport	800,000	Lille (France)	250,000
Glasgow	2,500,000	Magdeburg (Germany)	750,000	Melun ,,	210,000
,,	2,500,000	Altoona (U.S.A.)	750,000	Arles ,,	210,000
Manchester	2,500,000	Smethwick	750,000	Valencia (Spain)	200,000
Leicester	2,250,000	Schneider-Creusot Works		,, ,,	200,000
Swansea	2,000,000	(France)	735,000	Vercelli (Italy)	200,000
Bordeaux	2,000,000	Valparaiso (Chili)	600,000	Rawmarsh	200,000
Melbourne	1,500,000	Halle (Germany)	600,000	Baccarat (France)	175,000
Charlottenburg (Germany)	1,500,000	Elberfeld ,,	600,000	Hitchin	150,000
Derby	1,500,000	,, ,,	600,000	Sydney	100,000
,,	1,000,000	Nancy (France)	525,000	Balson-Chateauroux (France)	70,000
,, (Midland Rly. Works)	1,000,000	,, ,,	525,000		

RENEWALS TO 40 PATENT "STANDARD" WASHER-SCRUBBERS, viz:—

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Shoreditch (in part)	2,500,000	Crewe (L. & N.W.R. Co.)	1,250,000	Enfield	300,000
Beckton	2,500,000	Beckton	1,250,000	Harrow	250,000
Manchester	2,500,000	,,	1,250,000	Buxton	250,000
Bromley	2,000,000	,, (in part)	1,250,000	Quebec, Canada (in part)	250,000
Pimlico (in part)	2,000,000	Bradford	1,250,000	Reigate	200,000
Plymouth	2,000,000	Maidstone	1,000,000	Newmarket	150,000
Cheltenham	2,000,000	Smethwick	750,000	Leominster	150,000
Croydon	1,500,000	Heywood	600,000	Kidsgrove	100,000
Edinburgh	1,500,000	Heckmondwike	500,000	Driffield	100,000
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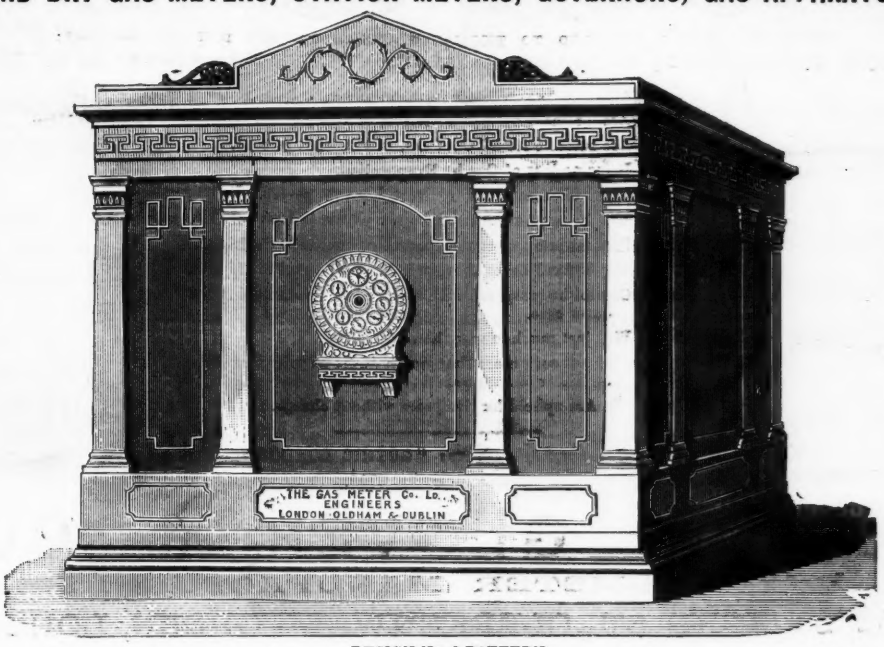

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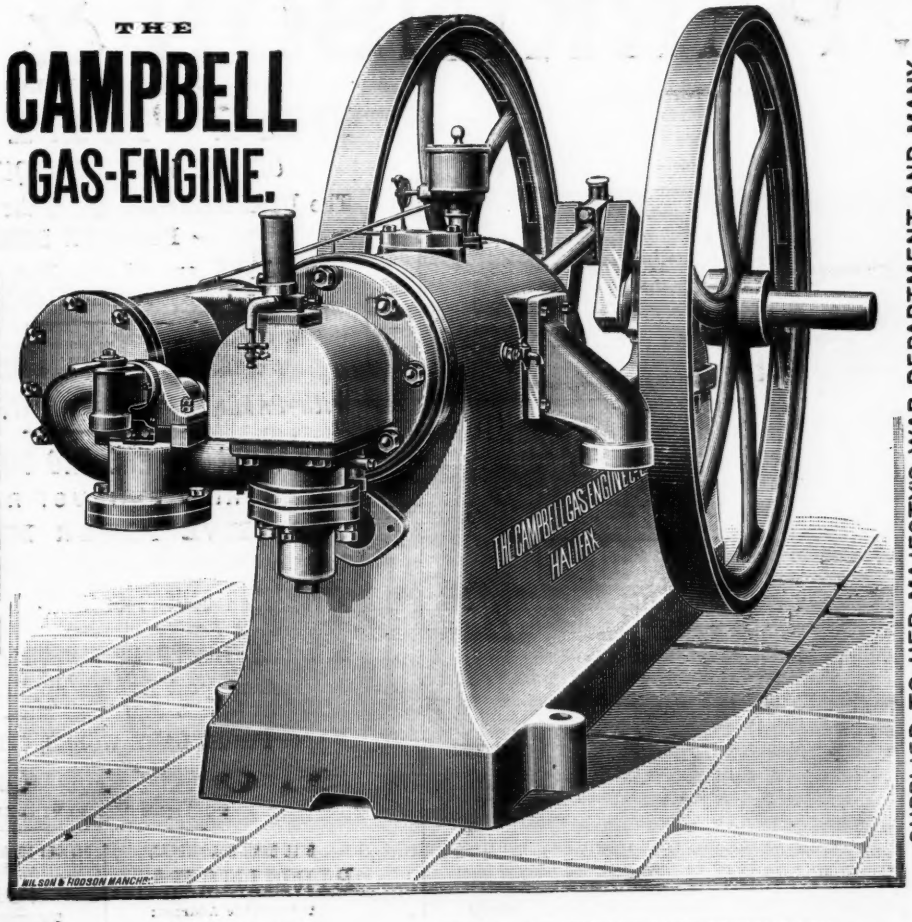

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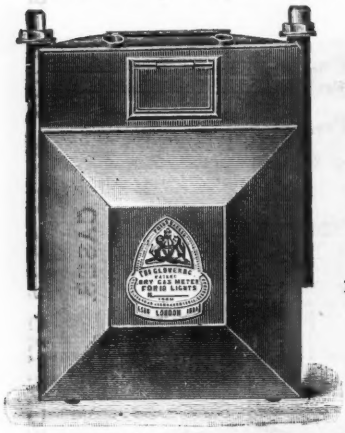

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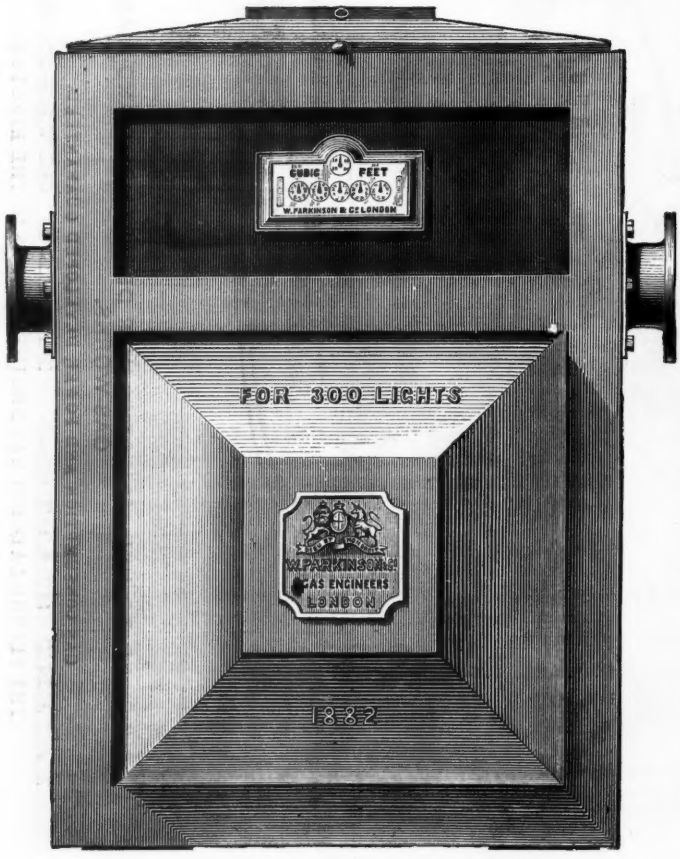

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TO CORRESPONDENTS.

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, SEPTEMBER 27, 1892.

Employers' Liability.

THE subject of the liability of employers for accidents to workmen is certain to attract increased attention in the immediate future. While politicians—chiefly those who happen to be out of office for the time being—talk about Old Age Insurance, and other developments of industrial politics which can only be hopefully discussed when the necessary data are better known than is at present the case, men of practical minds are considering the nearer questions which the condition of the labouring population constantly forces upon the notice of employers and employed. Prominent among these is the need for a more satisfactory definition of employers' liability and workmen's risk, in regard to those personal effects of the common employment in which the employers' money and the workman's life and limbs are hazarded. As the law now stands in this country, the liability of employers to compensate workmen or their legal representatives for loss of life or personal injury incurred in the course of their work is more of a conceded principle than an operative regulation. Many loopholes exist for the escape of unscrupulous employers from the obligation which the law, limited as it is, was designed to lay upon them in this regard. The proverbial "coach-and-six" has been triumphantly driven through the statute in various directions; and in the absence of cheap and expeditious means of obtaining justice, the injured poor stand little chance individually of securing their due, either under this or any other Act of Parliament. It is perhaps not an unmitigated misfortune that the first attempt at legislation in this regard has in this country been tentative rather than drastic. Root-and-branch methods of dealing straight off with the simplest evils of the body politic are seldom satisfactory; and it behoves the wisest and best intentioned legislator to take heed lest his efforts to right one wrong should create worse troubles.

The Employers' Liability Act has now, however, been in force long enough for its shortcomings to have become patent; and good employers must be in substantial agreement with the best workmen in desiring its amendment. We enter upon this subject as representing an order of employers whom we believe stand second to none in the wise liberality with which they are disposed to treat their workpeople in all circumstances, alive or dead, in sickness and in health. We do not claim any special degree of credit for the members of the order of gas-works administrators, collectively or individually, upon this account. They are no better than other men; but they occupy the position of being able to treat their labour costs as one of the first charges upon their undertakings; and they have no intelligible inducement to be otherwise than liberal to all their people, of every grade. Some there are among them who do not see things in this light. But they are the unpleasant exceptions to the rule of the generality; and with them we have no sympathy. Circumstances have conspired of late years to induce a general stock-taking in respect to the relations between employers and employed; and in no order of employment has this influence been at once more vindicatory and fruitful of good than in what may be called the protected industries—meaning by this term, in this connection, the occupations in which the pressure of trade competition does not weigh upon the paymasters. In this category fall naturally all Government and Local Authorities' services, as well as Gas and Water Companies' undertakings. The proportion of workers for this order of employers is now so considerable that the example of their treatment must be potent upon others differently situated. The responsibility of those in authority, upon whom rests the charge of making this example one to be followed or avoided, is therefore correspondingly heavy.

Now that the amendment of the law of employers' liability is under discussion, it will be well for gas-works administrators to take counsel together upon the subject, and see how far they can contribute, by example and illustration, towards the placing of the law upon a sound footing. Law does not so readily or so successfully create custom as follow it. We repeatedly see the "custom of "the trade" cited in the Courts to assist those whose duty it is to administer the law, in the frequently difficult task of applying general principles to particular issues. It is equally helpful, when new laws come to be drafted, if reference can be made to established customs justifying the proposed enactment. Suppose now that the amendment of the law of employers' liability for accidents to workmen is an "Order of the Day" in Parliament, upon what lines may it be reasonably expected that the reform will be pressed? Unquestionably, in the direction of increasing the responsibility of the employer by abolishing the exemption of "common employment," and by generally

approximating the English to the German rule—under which employers are liable for all kinds of accidents, except such as have no connection with employment, or such as are caused wilfully. The question of contributory negligence will also be sharply overhauled, if the plea is not wholly excluded.

This prospect appears at first sight very dreadful from the timorous employer's point of view. But it is not so terrible when boldly confronted. In the first place, in the great majority of industries (and particularly in the gas industry), it would not amount to a great deal if every workman killed or disabled from any cause while doing his ordinary work were to be compensated as a matter of course. The amount that goes to the lawyers in the event of one dispute would insure compensation for several men at the ordinary rates. Moreover, there is a good deal to be said on the same side, even if the low ground of argument is taken that the workmen in a factory should be considered in the light of machines, which the employer has to repair and renew as a matter of course. Perfervid orators sometimes allege, as a dreadful reproach against the existing industrial system, that in it "men are treated like "machines." As a matter of fact, under the present law, they are not so well off, because they commonly have to repair themselves. Then, with regard to the question of "contributory negligence," which is a favourite bone of contention. It may be considered in connection with the "inherent danger" of an occupation, which Mr. J. S. Jeans recently laboured to persuade the British Iron Trade Association Conference is "usually taken into account in "fixing the wages to be paid." This latter contention is a pernicious fallacy, of the fine old crusted variety that high-and-dry economists have left us, to prevent employers and workmen from seeing things of common interest in the same light. There would never have been any factory legislation, mine inspection, or other interference with the worship of the Fetish of Supply and Demand, if employers had been left to decide what are the permissible risks, or the inherent danger, of common employment. And as to the assertion that the risk is considered in fixing wages, how does this statement stand affected by a comparison of the rates of wages paid in coal-mining in the early part of the century, and now, when the industry has been rendered almost safe? Or has "Plimsollism" reduced the wages of sailors?

The truth of this matter is that in every kind of employment both masters and men are prone to regard an uncertain amount of risk as unavoidable or inherent, when it is nothing of the kind, but due to quite preventable laxity of supervision and insufficiency of protection on the one side, and rashness and ignorance on the other. Neither side has the monopoly of culpability in this matter; and when we say that employers, left to the guidance of high-and-dry economic doctrine, would do nothing to lower the death-rate of men in their service, it is not with a thought of ascribing wilful inhumanity to them. Over and over again it has come to pass that regulations and safeguards, proposed by employers with the object of rendering work less dangerous, have been rejected by workmen; and the recklessness of men in their work is something that must be seen to be credited. All these considerations have to be taken into account. And it must not be forgotten that seasons, hours of the day, individual temperament and state of bodily health—a hundred and one influences conspire to vary the character of the workman's employment from week to week, and from hour to hour. Again, some men can do things safely that would mean certain death to others. How can the resultants of all these effects be divided off as between those coming from the employer and those originating in the workman, so as to justly assign the pecuniary responsibility for what happens, say, when a man steps off a plank over which he has walked for weeks without damage? Even if a man is momentarily negligent, is he to bear all the suffering, and his family the loss—nobody helping them, "because it was his own fault?" Few of us would like to be judged by such a "cast-iron" rule.

There have been several ugly accidents in and about gas-works lately; and although the coroners' juries have returned verdicts of the kind that is quite usual when culpability cannot be ascribed to anybody in particular, incidents of this kind do not properly end in this way. We are particularly solicitous that, when the subject of employers' liability is discussed, with a view to the amendment of the law in the direction of greater stringency, it shall be possible to refer to the gas industry as a bright example of a class of employment in which liberal ideas of what is right and proper in the treatment of sufferers from accidents have operated without compulsion of law.

Meeting of the Institution of Gas Engineers.

THANKS to the public spirited initiative of Mr. Charles Hunt, the President of the Incorporated Institution of Gas Engineers, a meeting of the Institution will be held in Birmingham on Tuesday next. This is precisely the kind of proceeding which we have favoured from the inception of the organization; and, from the very sensible and attractive programme that has been arranged by Mr. Hunt and some of his friends, there is every reason for believing that the experiment of an autumn gathering of the Institution will be a pleasant experience for all who may be able to take part in it. Beginning with an inspection of the Windsor Street works, where there is a good deal of progressive gas engineering to be seen, members, after lunching with the President at the Queen's Hotel, will take train for Coventry, where they will be under the guidance of Mr. G. Winstanley, to whose courtesy and that of the Coventry Corporation Gas Committee they will owe this opportunity of inspecting the very interesting gas-works, and afterwards seeing the sights of one of the most historical towns in the kingdom. Members who are enabled to spare a second day will form a party for a round trip on Wednesday from Birmingham to Warwick and Stratford-on Avon, by rail and brakes. This is a most enjoyable excursion through a country rich in landscape beauty and storied interest. It will be noticed that there is no formal technical business of any kind in the programme. It is greatly to be hoped that the response to Mr. Hunt's invitation will be such as to recompense him and Mr. Winstanley for the trouble they have taken in arranging this extraordinary meeting.

The Eastern Counties Association Meeting.

THE members of the Eastern Counties Gas Managers' Association met at Lowestoft last Wednesday, under the presidency of Mr. C. E. Jones, of Chesterfield. The technical part of the programme of the day consisted in the reading and discussion of a paper by Mr. W. J. Carpenter, of Yarmouth, on "Carbonizing Methods, "Past and Present," which was a very suitable contribution to the transactions of such an Association. The Directors of the Lowestoft Water and Gas Company hospitably entertained the members and their friends; and upon this point, it is only necessary to remark that a District Gas Managers' Association in such case usually attracts a strong contingent of "well-wishers." *Verbum sap!* In the afternoon, the party drove to Lound, whence the water supply of the town is obtained; and they afterwards dined together—the Mayor and the Chairman of the Gas and Water Company being of the number. Mr. W. Duesbury, of Cambridge, is President for the ensuing year; and the spring meeting of the Association will be held in that city. The Association appears to be flourishing; and it certainly rejoices in the possession of one most important aid to success—the services of an able and painstaking Honorary Secretary in the person of Mr. H. Wimhurst, of Sleaford. The autumn meetings of the District Associations are usually among the best attended gatherings of the kind that come under our notice; and this meeting was certainly no exception to the rule.

The Misuse of Terms.

A TYPICAL newspaper scribe employed upon the staff of the *Sheffield Daily Telegraph* has been poking ponderous fun at Sir Frederick Mappin, M.P., for venturing to state, at the recent meeting of the Gas Company, his opinion that if the principal producers of gas-works residuals would but determine to have a fair price for such commodities, purchasers would be compelled to pay it. Whether this opinion—in holding which, the Chairman of the Sheffield Gas Company is not alone—is or is not well founded, is a matter upon which we do not desire to say anything just now. Our reason for referring to the point is simply to expose a common trick of newspaper writers, whose trained facility in the use of catch-phrases frequently lends to their criticisms of the words of public men an appearance of authority which but thinly covers a substratum of drivel. In the case under notice, the writer thinks to

overwhelm Sir Frederick Mappin with ridicule by alleging that his aspirations point to a "corner in tar"—a "ring in anthracene;" and that accordingly he must be a Protectionist. It is most remarkable how handily these terms "Protectionist" and "Free Trader" come to writers who would be greatly puzzled to define their meaning if deprived of the help of convenient illustrations. Whenever such a classification is applied to a public man by the order of writers whom we have in view, it is always meant as a term of reproach. Newspaper controversies are full of this kind of thing. Some people may fail to appreciate the humour of calling Sir F. Mappin a Protectionist because he happens to think the coal-tar market had been spoilt. But our newspaper gentlemen must have their little jokes, especially when these require a good amount of explanation, because this is an easy way to fill up columns. It should not require argument to prove that the question whether the sellers of any commodity can or cannot get their own price for it, has no more to do with Protection or Free Trade than it has with conic sections or the nominative case. If a man is about to buy or sell, he may make a good or a bad bargain according as circumstances and his own commercial aptitude (or the lack of it) determine his action. Where does the question of Free Trade or of Protection come into the action of a manufacturer (say) of aluminium, who should agree with others in the same trade to sell only at a certain price? He takes his risk—firstly, of the purchaser being compelled to come to him in default of getting supplied elsewhere, and, secondly, of his own ability to wait while the latter experiment is being tried. The agreement may or may not result satisfactorily to the seller; but it can as well be tried in Free Trade England as in M'Kinley-ridden America. The puzzles of commerce are hard enough to solve for all of us, without our muddling them up unnecessarily by the wrong use of terms.

A Strange Congress.

A French contemporary notices an odd appeal, which emanates from a knot of gas consumers in Lyons, and is addressed to the inhabitants of every French town "groaning under the yoke of Gas Companies," for a national meeting of these malcontents to be held in Lyons some time in October. The object of this curious assemblage is declared to be that of initiating in advantageous circumstances a struggle against the Gas Companies "who abuse their powers by oppressing "consumers, selling at a usurious price a commodity "which, in consequence of the advance of science, costs "next to nothing." The gas consumers of France are called upon to combine like the Companies, and "form "a redoubtable faggot, against which the pretensions of "these omnipotent companies will be shattered." Our contemporary seems disposed to take this rhodomontade seriously—protesting that none but an ignoramus or a charlatan could have conceived the ideas expressed in this Lyons manifesto. The incident, however, strikes us more as a ludicrous ebullition of fussiness, in which ancient and modern notions are inextricably confused. The idea of a Congress is, of course, distinctly modern. Our English gas agitators, who have been dead and buried for these twenty years or thereabouts, never rose to the conception of a Congress of discontented consumers. This is the modern "note" in the incident. The ancient part of it consists in the innocent assumption that Gas Companies, whether they happen to be strong or weak, can be cowed by being called hard names in any language. French, moreover, as many people have observed, is a very pretty tongue for making compliments in; but its vocabulary of abuse is singularly weak and pointless. If our French friends want to use strong language about Gas Companies, they must first learn the American tongue. A glance through the bibliography that has accumulated in the States—say, round the single name of Addicks—would reveal more gems of opprobrious diction on the general subject of gas supply than a French Congress of dissatisfied consumers could produce in a week's sitting. Yet nobody is noticeably the worse for it all. Hence we conclude that it is waste of time and breath to get up gas "agitations," either by way of a "Congress," or otherwise. When ordinary commercial considerations fail to keep a particular gas supply within the rule of reasonableness and fair dealing, it is hard to say what other power of inducement or control will serve the turn.

WATER AND SANITARY AFFAIRS.

Without intending the slightest reflection on the Royal Commissioners who are investigating the subject of the Metropolitan Water Supply, we cannot but regret that the evidence of Sir George Buchanan makes its appearance only as a *précis* in the *British Medical Journal*. It seems to us that the evidence of so important and influential a witness as the late Medical Officer of the Local Government Board, should either have been left to the custody of the Royal Commission, or should have been given at a meeting open to the usual representatives of the press. All we can learn at present is that the evidence was adduced "at a special sitting." We feel sure that the Commissioners could have entertained no idea of excluding the press; and the apparently private nature of the proceedings must have been purely accidental. Taking the story as it comes to us, we find Sir G. Buchanan throwing discredit upon any favourable conclusions which may have been derived from chemical or bacteriological tests as to the quality of water. The whole tenor of his evidence is to incite suspicion as to the character of the London Water Supply, and to set aside as delusive all known methods of examining into its purity. The report on which we have to found our remarks, seems to indicate a desire on the part of the Commissioners to employ some scientific mode of investigation, so as to see "whether pathogenic organ-"isms could be recognized and identified in filtered Lon-"don water." But Sir George gave them no encouragement to enter on such an inquiry. All he could recommend was that they should undertake what he designated "field "observations"—that is to say, the Commissioners should go and look at the rivers and streams, and see whether anything got into the water which ought not to be there. We can fancy Lord Balfour of Burleigh and his colleagues acting as a roving Commission on the banks of the Thames and the Lea, and taking notes of the phenomena coming under their notice. This is all that is required in order to support the theory espoused by the ex-Medical Officer. His position is simply this—that if water is once obtained from what he would call a polluted source, there is nothing more to be done, but "either to boil it or let it alone." The so-called pollution, compared with the actual stream, may be infinitesimal; and the subsequent filtration may exclude 98 or 99 per cent. of the microbes—the whole lot being probably harmless. But the entire supply is to be condemned, on the ground that it must either be unwholesome or liable to become so; while at the same time there is not the slightest evidence to show that the water is otherwise than good. We would ask, Where is the water to be found that is entirely free from pollution? Supposing a supply to be drawn from Wales or Westmoreland, is there any guarantee that nothing objectionable shall enter the supply on its long journey to London? Pollution, for all practical purposes, is a question of degree. A sparrow drowned in a domestic tank has, by its putrefaction, rendered the water poisonous. But will a decomposing sparrow in a reservoir poison a whole city? Sir George Buchanan, while disparaging scientific tests as applied to the London Water Supply, suggests that the Medical Department of the Local Government Board has not had money enough to pursue this kind of investigation as it "ought to have done.' 'Hence Dr. Dupré's researches have been kept in abeyance. So, until the "limited purse" of that department is duly extended, we must rely solely on "field observations."

One part of Sir George Buchanan's evidence before the Royal Commission stands out distinctly from the rest; and therefore justifies separate consideration. Reference is made to "the condition of the subsoil of the Staines "sanitary district," as imperilling the purity of the river above the intakes of the Water Companies. This topic is also brought forward in a letter to *The Times* from the Chairman of the Port of London Sanitary Committee, who indulges in some sweeping assertions as to matters growing worse year by year, and goes so far as to say that "the "Thames Conservancy Board should put an end to the "water being used for drinking purposes." How much time he will allow for this operation, the proposer fails to specify. A few years would, of course, be needful; and, in the meantime, it is very satisfactory to know that the Conservators are not inactive. Prior to last July, they had served notices in 121 cases in Staines; and some of the parties concerned had already ceased to pollute the stream.

Constant inspection is going on, not only with respect to Staines, but in the case of every source of pollution, however slight, on the river side, and for some miles up every tributary as far as Cricklade. If anything is needed, it is an amendment of the law, so as to simplify the proceedings, and render action more expeditious. As to the state of the subsoil in the Staines sanitary district, alluded to by Sir G. Buchanan, we believe we are right in saying that the soakage, be it much or little, only reaches the river after percolating through a mass of gravel which constitutes an excellent filter-bed. The *Pall Mall Gazette* has mentioned the fact that, when typhoid fever was epidemic at Staines, no appreciable effect was produced on the rate of mortality in London, either in regard to ordinary disease or maladies of a zymotic type.

Flexible Metal Tubing.—Early in the present year, Mr. Gilbert R. Redgrave, Assoc.M.Inst.C.E., read before the Society of Arts a paper in which he described the method of constructing flexible metallic tubing. More recently, he introduced the subject at the meeting of the British Association in Edinburgh. The new flexible tubes are the invention of Mons. E. Levavasseur; and he was led to the discovery by his successful attempts to produce necklaces and bracelets of the well-known snake pattern. In the first instance, these ornaments were manufactured by means of spirally wound strips of thin metal of two different sections, so arranged that the joints produced by the lower fillet were covered by a second fillet wound above it. At a later date, M. Levavasseur manufactured similar objects by the use of a single spirally-wound fillet in the shape of an **S**; the coils being so disposed that the head of one **S** was clasped by the tail of the next. About six years ago, however, the inventor, on observing the clumsy contrivances to obtain flexibility in the hose used in Paris for watering the roads, was induced to turn his attention to the manufacture of pipes and tubes of larger dimensions; and this he at first attempted to do by employing the **S** section already used for jewellery, with the addition of a thin strip of india-rubber inserted along the joint. Some very successful tubes were made in this way; but finding the rubber was liable to become rapidly worn out, and that in certain cases it soon oxidized or became useless, he determined to prepare a tube in which this material could be dispensed with. To do this an entirely new section was designed, which may be described as a double channel. In coiling this strip, the smaller notch fits into the larger one, and room is allowed for a certain amount of play, so that a species of piston joint is obtained, as the small notch works within the larger one in a very similar way to that in which the piston travels in the cylinder. In tubes thus made it becomes possible to omit the rubber, and to obtain a perfectly tight joint between the metal surfaces. Recently, by an improvement in the processes of manufacture, it has become possible to produce a flexible pipe with the coils soldered together as the tube is formed; and the flexibility is obtained by the extension and compression of V-shaped folds in the metal.

The Absorption and Filtration of Sewage on Sandy and Other Soils.—At the recent meeting of the British Association in Edinburgh, Mr. R. F. Grantham, M.Inst.C.E., submitted a paper on the above subject. He referred to what were described as the remarkable results of the experiments conducted for the last two years at St. Lawrence by the Massachusetts Board of Health upon the filtration of sewage. The results were compared with instances of sewage farming upon sandy soils. The examples of sewage irrigation at Edinburgh, Dantzic, and Berlin were described; and the effect upon the sandy soil in each case, as well as the average quantity of sewage treated per acre per day, was alluded to. The particulars of the filter-tanks constructed and the materials used by the Massachusetts Board in their experiments were stated. The tanks were 6 feet deep, built water-tight; and 17 ft. 4 in. in diameter at the top, and 16 ft. 8 in. at the bottom. Two-inch drain-pipes and a thickness of 1 foot of gravel and sand, decreasing in coarseness upwards, were laid and spread at the bottom. Above this layers of sand and gravel and other materials were placed in several tanks. The sewage was delivered on the surface of the filters intermittently. The volumes of sewage dealt with in sewage farms were contrasted with the quantities experimented upon; and Dr. Frankland's experiments for the Rivers Pollution Commissioners were mentioned as corroborating the results of the Massachusetts Board's investigations as regards the quantities and degree of purification. The action of the filters was shown to be not merely in straining the sewage, but in consuming and destroying the organic impurities; and this action was due to the presence in it of organisms which require a supply of oxygen for their existence and multiplication. From the quantity of sewage disposed of on the Berlin sewage farm per acre and from that ordinarily absorbed by intermittent downward filtration were calculated the areas of land that, according to the same ratios, would be required for the disposal of the London sewage; and these were compared with the space required for the volume according to the ratio shown by the experiments. It was suggested that there would be no difficulty, from the nature of the formation of the Maplin and Foulness Sands, in reclaiming and underdraining them, and laying them out for filtration areas.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 565.)

THE agitation which was prevalent in the Stock Exchange in the previous week has subsided; and the week just closed has been calm and tranquil. The tendency in the earlier portion was towards higher prices, though there was not much done in anything except the high-class securities. The intervention of the Jewish holidays produced a marked break in the week, and caused business to be very quiet. The tendency at the close was decidedly flat, owing largely to some degree of apprehension being entertained with regard to the settlement next week. The Money Market has been a little more animated—money being in better demand; but there was ample to meet all requirements. Business in Gas has not been particularly brisk. But the market is very firm; and several of the more important issues, both ordinary and secured, have advanced in value. The few exceptions, which have receded in quotation, are influenced by special circumstances peculiar to themselves. Of the Metropolitan undertakings, Gaslight "A" was as steady as a rock; being done every day at 218, or a fraction above or below. Owing to the continued demand for investment stocks of assured position, the debenture, preference, and limited issues of the same Company fully maintained their recent activity, and show further advance in value. Their quotations are higher now than they have been at any time during the last twelvemonth. In South Metropolitan, nothing was dealt in but the "B." The stock still keeps moving up; showing a gain of 2 in the week. A few transactions were marked in Commercials at improved prices; but the only change in quotation was an advance of 1 in the new stock. The Suburban and Provincial undertakings offer no feature for remark; and their old quotations hold good. The Continental division are firm and generally quiet; but Continental Union is 1 higher. Of the rest of the Foreign Companies, Bombay new recedes ¼, owing probably to the exchange; and San Paulo is ½ worse—the meeting held for the purpose of raising money upon debentures not having been wholly satisfactory. Water is quiet and steady; and New River debentures are up 1.

The daily operations were: Gas opened unchanged, and remained firm and quiet during the day. Commercial new rose 1. Business was as restricted on Tuesday; but prices moved up. Gaslight "C," "D," and "E" rose 2; ditto, 4 per cent. debenture, 1; and Continental Union, 1. Wednesday's transactions were about up to the average; but no quotations changed. Thursday was very quiet; and still the old prices held good, except for Bombay new, which fell ¼. On Friday further progress was effected, South Metropolitan "B" leading with a rise of 2; and Gaslight "C," "D," and "E" improving 1. San Paulo lost ½. Saturday produced further advances. Gaslight "H" rose 2; and the 10 per cent. preferences, 1 each.

ELECTRIC LIGHTING MEMORANDA.

Will there be any Electricity in the Future?—Electricity a Product of the Age—The Supply of Gas and of Electricity in Fogs.

IT is hardly to be wondered at that electricians, who have some justification for regarding themselves as representing the youngest born, and consequently the favourite, offspring of physical science, should occupy themselves so devotedly as they do with the question of electrical power transmission. It is already evident that the possibilities of telegraphy, in all its known forms, can be marked off with fair exactitude and completeness. Electric lighting also, large as is its field, is not sufficient to satisfy all the aspirations of workers in electricity. There is a great gulf, however, between the objects to which the hopes of electricians extend, and the actualities to which they are for the present bound. Perhaps we shall be held justified in making the statement that the keynote of the tone of discontent which underlies so much of the utterance of thoughtful electricians is traceable in the consciousness on their part that, so far, electricity in practice is only another method of using up coal. We cannot get away from the uncomfortable reflection that the world's stock of coal is being consumed; and that, so far as we can see, there is nothing to take its place when it shall be gone. Every art and industry that depends upon coal is essentially of a temporary nature; for how anything of the kind is to be carried on after the coal is all burnt, passes the wit of man to conceive. This reflection does not greatly trouble those of us who are connected with the coal-gas industry; because we do not live in the future, but in the present. It is widely different, however, with the electricians, who are fain to look to their prophets for encouragement. But prophecies of "a good time coming" for electricity, must not look too far ahead, or else they will land in the *post*-coal age, which would be quite as comfortless to the electrician as to the gas engineer.

If electricity contained within itself the germ of the possibility of dispensing with coal, or even of rendering an age of dear and scarce coal less penible than to us it must necessarily threaten to be, there would be more true hopefulness among its partisans. The problem of superseding coal as the ultimate source of

energy is closely allied to that of conveying energy from one place to another; and in neither case does electricity at present help us forward to a general solution. A good deal is said about the prospect opened up by Professor Forbes's Niagara scheme; and it must be conceded that Professor Forbes is keener than most electricians in desiring to eliminate steam coal from the practical problem of electrical supply. Most electrical engineers appear to prescribe Babcock and Wilcox boilers as a matter of course, wholly ignoring the obvious truth that by so doing they proclaim electric light and power as essentially a product of the present—a result of abundant and low-priced coal—and no more a possibility of the future than is a gas-works.

Referring to the fogs of the coming winter and their possible effects upon the central-station electric lighting companies, our contemporary the *Electrician* remarks that it is not so easy to obtain timely warnings of the arrival of fogs or to mark them down in different parts of London as some people new to this class of business appear to believe. If fogs came up the river like tidal waves, it would be practicable to keep track of them; but, says our contemporary, "if there is anything more characteristic about a London fog than its colour and persistency, it is its frequent suddenness and sporadic distribution. Darkness rivalling that of midnight often supervenes within five minutes of comparative brightness, and as often as not passes away in thrice that time." It is remarked also that different kinds of fogs affect gas and electric light undertakings quite differently. "For a gas-works manager, a sudden fog has no terrors; all he dreads is persistent darkness, exhausting his reserves of gas. The central station (electrical) engineer, on the other hand, has no storeage to speak of; his only reserve is idle machinery, of which he has generally enough and to spare. Hence fogs of long duration, provided no hitch occurs in the coal supply, are a positive boon to him, while a sudden darkness is his *bête noir*." There is much truth in these observations; but they do not exhaust the subject. There is hardly as yet a sufficient stock of experience upon which to draw for evidence in support of the statement that fogs of long duration are a positive boon to the central station electrician. It is rather a bold assumption that the coal supply will always be right for him, seeing the difficulties that fogs, with their accompanying frosts, put in the way of traffic. It is not all fogs that are attended by hard frosts, it is true; but in London at any rate, all severe frosts are accompanied by a thickness of the atmosphere which is entitled to be called fog. It is important also to bear in mind that general, persistent fogs are more easily foreseen than the sporadic ones. Gas managers are sometimes caught napping; but during the winter months whenever the thermometer shows a tendency to go down, and the barometer to rise, fogs are imminent. Sporadic fogs are common in autumn and spring; and perhaps they have some connection with the occurrence of violent alternations of night and day temperatures. Practically, however, it is impossible to tell where or when they may occur, or how long they may last. Over and over again every year, all the lights in a certain district will be lit up at a moment's notice—only to be turned out again a few minutes, or perhaps an hour, later. There are no means whereby the central station electrical engineer can assure himself against these visitations, or provide for them when they come. If he could be certain that they would only last a short time, he might leave the consumers to grumble; but it is impossible to do this, for business cannot be suspended during short spells of fog to suit the exigencies of the electrical distribution service. Consequently, the electricians must chase the fleeting fog as best they may. The gasholder merely sits down upon it.

New Lights on the West Coast of Scotland.—Two very large gas-buoys, built by Messrs. Hanna, Donald, and Wilson, of Paisley, have recently been placed in position, says *Industries*—one in the Sound of Kerrara, and the other in the Sound of Islay. In addition to these, Messrs. Stevenson, of Edinburgh, the Engineers to the Northern Lighthouse Commissioners, are erecting three beacon lights—in the Sound of Raasay, in the Sound of Kerrera, and in the Sound of Jura respectively. A small oil-gas works has been established at Oban, in order to supply the reservoirs of these lamps.

Interesting Discoveries at the Tewkesbury Gas-Works.—Since last Easter extensive operations have been in progress for the erection of a new gasholder of large capacity at the Tewkesbury Gas-Works. During the excavations, some interesting discoveries of human remains have been made which had probably lain in the places they were found since the early Britons had a settlement on the site of Tewkesbury, and a burying-place on and about where the gas-works now stand. The new tank for the holder is being constructed in a portion of a large garden adjoining the works; and it is here where, since the commencement of the work five months ago, six distinct skeletons have been found about seven feet below the surface. A similar number were unearthed when the old gas-works were made in 1832-3; and at that time old pottery and various other remains were found. During the extensions now going on, the skeletons and one silver coin have been met with; the latter, however, was lost in the mud before it had been examined, and could not be recovered. The present and former discoveries justify the supposition that the place was a burying-ground in probably early British times.

GAS ACTS FOR 1892.

According to custom, we herewith commence our summary of the chief provisions of the Acts of Parliament relating to gas supply which became law during last session.

The Rhymney Valley Gas and Water Act incorporates a Company, with a capital of £50,000 (£20,000 appropriated for gas purposes, with power to borrow £5000 in respect of the same), for the supply of a district occupying part of the Valley of the Rhymney river in Glamorganshire, together with an adjacent district in Monmouthshire. The Company also acquire the undertakings of the Bargoed and Hengoed Gas and Water Companies, upon the terms of scheduled agreements. The price covenanted to be paid for the former property is £6250, payable in Rhymney Valley shares; and for the latter the sum of £4500, also in shares, together with the taking over of a mortgage debt of £600. The maximum price of 15-candle gas is fixed at 6s. per 1000 cubic feet. The Western Valleys (Monmouthshire) Water and Gas Act authorizes the transfer of the undertaking of the Risca Gas Company to the former Company, in consideration of the sum of £9000 in shares carrying a maximum dividend of 10 per cent., together with the payment of such a sum not exceeding £2000 as may have been expended on the undertaking out of capital between December and July last. Fifteen-candle gas is to be supplied at the standard price of 5s. per 1000 cubic feet. Additional gas capital to the extent of £20,000, with the usual proportion of loan capital, may be raised, whereof £9000 is to be original capital representing the structural value of the undertaking of the Risca Company, and the remaining £11,000 is to be 7 per cent. additional capital—all to be raised under the auction clauses. Power is given to the Risca Local Board to buy the undertaking within the next five years. The name of the Company is changed to the Western Valleys (Monmouthshire) Water and Gas Company.

The Bexhill Water and Gas Act empowers the Company, who were incorporated in 1885, to raise £10,000 of additional share capital, and to borrow £2500 in respect of the same. The Bristol Gas Act authorizes the acquisition of additional lands for storeage purposes, and also the purchase by agreement of 15 acres of land for extraordinary purposes, and the sale of surplus lands. The Brynmawr and Abertillery Gas and Water Act defines the capital of the Company under former Acts to be £18,000 in shares and £6500 by way of loan. New capital to the amount of £40,000 is to be raised, of which £10,000 is to be gas capital, with power to borrow one-fourth of the amount raised. Clauses are inserted enabling the Company to deal in gas-fittings; to supply gas for trade purposes by agreement; to sell gas in bulk; to demand payment for gas in advance in certain cases; and to allow discounts for prompt payments or for large consumption, on condition that all consumers are treated alike and that the discount does not exceed 10 per cent. for prompt payment, or 20 per cent. for large consumption. The period of error in defective meters is limited to the current quarter. The East Grinstead Gas and Water Act empowers the Company to raise £40,000 of additional capital, with the usual proportion of loan, and to acquire additional lands and enlarge their works. Gas mains and services may be laid in undedicated roads. The Company can build and let residences for their officers and servants. Power is also given to deal in fittings, and to apply for an Electric Lighting Order. The gas is to be of 15-candle power; prepayment may be demanded in certain cases; and the period of error in meters is limited to the current quarter. The Liverpool United Gaslight Company's Act authorizes the extension of the Company's storeage plant upon certain lands—subject to the provision that the capacity and height of the gasholders proposed to be erected are to be such as shall be agreed by the Company and the Corporation of Liverpool; any difference arising to be settled by arbitration. Sanction is also given for dealing in gas-fittings. The Ormskirk Gas Act empowers the Company to raise £20,000 of new capital, carrying the usual borrowing powers. The Company's limits of supply are extended so as to include the townships of Lydiate, Maghull, and Melling, in Lancashire, and so much of the townships of Scarisbrick and Halsall, in the same county, as are not within a circle of the radius of 6 miles from the Town Hall in Southport. Additional lands are to be acquired and gas-works constructed. For the protection of the Ormskirk Local Board, it is provided that the proposed extensions of district authorized by the Act shall not increase the price of gas to the Local Board or to any consumers within their district. In the event of the extensions being made, the Company are to keep separate accounts showing the receipts and payments both on account of income and capital in respect thereof and of the supply of gas to such places, and shall produce the looks relating thereto to the Local Board or their agent at all reasonable times upon receiving seven days' notice. In connection with their manufacturing operations, the Company are enjoined not to do any injury to the sewers of the Local Board or to their sewage farm. If the Company do so offend, or create any nuisance, they are to incur a penalty of £50 and £10 a day, with costs. Nothing in the Act is to exempt the Company from any other penalty to which they may be liable for causing a nuisance. The maximum price for the Company's 15-candle gas is 5s. 6d. per 1000 cubic feet. The usual powers for dealing in gas-fittings, &c., are given. If any alterations of

the position of the Company's mains and pipes are required by any highway authority, the Company are to do the work at the expense of the authority, or the latter may in default do it themselves. In connection with notices of discontinuance, it is provided that a consumer is to be liable for all gas consumed up to 48 hours from the giving of such notice.

The Oxford Gas Act contains the following provisions relating to capital: As from last June, the capital of the Company is defined to be £143,892, whereof £47,112 is 5 per cent. preference stock, and £96,780 is consolidated ordinary stock. This preference stock and consolidated ordinary stock are divided among, and vested in, the former shareholders, in proportion as follows: £18,000 of preference stock and £18,000 consolidated ordinary stock go to holders of A shares; £600 consolidated ordinary stock are divided among the holders of B shares; and £29,112 preference stock and £72,780 consolidated ordinary stock are allotted to the holders of C shares. Additional capital to the amount of £100,000, in the form of consolidated ordinary stock, is sanctioned, to carry the usual proportion of loan. The same proportion of one-fourth may be borrowed in respect of any premiums received upon the sale of shares or stock. The dividends payable by the Company are limited to 5 per cent. on all preference stock; and 5 per cent. on all consolidated ordinary stock. The initial price of gas consumed within the city is 3s. 2d., and outside the city limits 3s. 8d. per 1000 cubic feet, with the sliding scale at the usual rates of one-quarter per cent. for a penny up and down. Certain clauses of former Acts, requiring the Company to pay over surplus profits to the Local Authority are repealed, in favour of the provision that the Company shall, within three months after the passing of the Act, create and issue to the Corporation of Oxford one or more debentures to the aggregate amount of £1000, bearing interest at the rate of 5 per cent. per annum, payable half-yearly as from this Michaelmas; "and the moneys arising from time to time from the paying off or sale of any such debenture or debentures, shall be applied by the Corporation of Oxford for such purposes only as shall be from time to time sanctioned by the Local Government Board." The limits of supply are extended so as to include the whole of the City, and the parish of Wolvercote, in the county of Oxford; and the acquisition by the Company of a piece of land is confirmed. The ordinary general meetings of the Company are henceforward to be held annually, instead of half yearly; and an interim dividend is to be declarable. Four testing-places for pressure are to be provided within the City, and at distances of not less than half a mile from the works.

The Southend Gas Act enables the Company to raise £28,000 of additional capital, with the usual borrowing powers. Additional lands are to be acquired for manufacturing purposes; and a jetty to carry a 3-feet tramway is to be constructed, the trucks to be worked by animal power only. Power is conferred for dealing in gas-stoves, &c. The illuminating power of the gas is to be 15 candles; and the initial price 4s. 6d. per 1000 cubic feet. The Stamford and St. Martin Stamford Baron Gas Act repeals an Act of George IV., whereby the Company was incorporated with a share capital of £5625. Prior to the year 1827, the capital of the Company was increased, by contributions from the original shareholders, to £11,250; and since then £10,000 has been expended upon the works out of revenue, so that the works, together with working capital, are at present valued at upwards of £22,000. The Company remains incorporated under the same name as before, and is continued in all the usual functions and offices. The capital is declared to be £25,750; of which £15,750 is called the original capital, and the remainder the additional capital, to be raised under the auction clauses. The original stock is appropriated to the old shareholders in the proportion of £70 for every existing £50 share in the Company. The maximum dividend on the original stock is 8 per cent. Borrowing powers extend to £3937 in respect of the original capital of £15,750, and to one-fourth of the new capital. The limits of supply are defined to lie in the three counties of Lincoln, Northampton, and Rutland. Additional lands are to be taken for manufacturing purposes. Fifteen-candle gas is to be supplied, at the standard price of 3s. 6d. per 1000 cubic feet. The Cleator Moor Local Board Gas Bill authorizes the transfer of the undertaking of the Cleator Moor Gas Company, Limited, to the Cleator Moor Local Board, and repeals the Cleator Moor Gas Order of 1872. The district of supply is the combined districts of the Local Board and the Gas Company. The sum of £14,000 is to be borrowed for the purposes of the Act, besides the purchase-money for the undertaking, and the costs of the Act itself. The agreement for the transfer is scheduled. It provides that the consideration for the purchase of the works shall be the sum of £16,000. The amount of money to be expended by the Company in repairs and renewals up to the date of transfer is mentioned, as is also the quantity of gas to be in stock on that day. The Local Board are entitled by this agreement to purchase from the Company so much of the stock in trade as they may think necessary, for a price to be determined by the Company's Manager and the Local Board's Surveyor. The maximum price of 15-candle gas is 4s. 7d. per 1000 cubic feet; and discounts not exceeding 20 per cent. may be allowed in consideration of prompt payment and of large consumption. Twenty-four hours' written notice of discontinuance is required, in default of which the consumer is to be liable to pay up to the period of the next meter-taking. The Southborough Local Board (Gas) Act empowers the Local Board to acquire the undertaking of the Southborough (Kent) Gaslight and Coke Company, Limited, who obtained and Order in 1891, which contained a clause providing for the transfer. The district of supply trenches upon that of the Tunbridge Wells Gas Company, whose consent has to be obtained before the powers of this Act can be exercised within certain limits. In addition to the sum necessary for the purchase of the Company's undertaking, the Local Board are authorized to borrow for the improvement and enlargement of the works the sum of £15,000, besides the cost of obtaining the Act. The maximum price of gas is 4s. 8d. per 1000 cubic feet.

The Blackburn Corporation Act contains a clause making the provisions of section 14 of the Gas-Works Clauses Act, 1847, and of section 18 of the Gas-Works Clauses Act, 1871, apply to any gas-meter or gas-fittings belonging to the Corporation, notwithstanding that such meter or fittings shall not have been let for hire or for remuneration in money. The limits of gas supply are also extended to include the township of Billington. The Middlesbrough Corporation Act empowers the Corporation to acquire additional lands for the extension of their gas-works, and to make a new street in connection therewith. The sum of £50,000 is to be borrowed for these purposes, repayable in 40 years. All expenditure not exceeding £8000 made before the passing of the Act for the purchase of gas-stoves, &c., is ratified; and the amount is to be repaid by five equal annual instalments out of the gas revenue. The Newcastle-upon-Tyne Improvement Act contains a clause authorizing the Corporation to agree with the Gas Company with regard to the testing of gas at any place other than the works of the Company, such places to be statutory testing-places within the meaning of the Company's Act of 1879.

NOTES.

The Spheroidal State of Water.

M. Witz has made a communication to the *Comptes Rendus* respecting the production of the "spheroidal state" of water in steam-boilers, which has been suggested by Boutigny as a possible cause of boiler explosions. It is premised, according to this theory, that when, through the water-level having been allowed to fall too low, with the fire alight, the metal over the furnace has become red hot, the water that may be pumped upon the heated plates remains in the spheroidal state, and there is scarcely any production of steam; but when the temperature of the metal falls below 170° C., the water again makes contact with it, with the result of a sudden and enormous evolution of steam, which wrecks the boiler. This hypothesis appears to be confirmed by certain well-known lecture experiments. Thus, a miniature boiler explosion can be produced in a small copper flask—the end of the spheroidal state being signalized by the blowing out of a cork. M. Witz has recently investigated the conditions necessary to the production of the spheroidal state of water, and has found that the rate of evaporation increases rapidly with the heat of the containing metal up to a temperature of about 320°C.; but, at a red heat, the evaporation falls to little or nothing. These experiments were conducted with a container open to the atmosphere. Tests were then made with an upright cylindrical boiler, having a flat circular bottom, and kept constantly supplied with water while strongly heated, at first by atmospheric gas-burners, and finally (as giving the highest temperature) by a coke fire with forced blast. The bottom of the boiler never got red-hot; and the rate of evaporation increased continuously with the intensity of the heat. Then the supply of water was stopped; the contents of the boiler evaporated completely, and its bottom became red-hot. It was now in the condition of an ordinary boiler which has become overheated owing to an insufficient supply of water. If, then, the admission of water into such a boiler results in the production of the spheroidal state, this would appear by a marked reduction in the rate of evaporation in the ratio of 30 to 1, or thereabouts. However, on admitting water into the boiler, it was found that the rate of evaporation was not reduced but was actually increased. The author concludes that, in actual practice, water does not assume the spheroidal state in a red-hot iron boiler; but that, under these conditions, the rate of evaporation attains a figure so high as to merit the careful attention of engineers with a view to practical results.

Cholera and Carbolic Acid.

It is suggested by the *Chemist and Druggist* that one effect of the appearance of epidemic cholera in Europe will be such a reanimation of the carbolic acid market as may be expected to make a welcome exception to the prevailing stagnation in the chemicals trade. Carbolic acid appears to be the chief, if not the only disinfectant resorted to by the Russian officials. The State Medical Department has ordered immense quantities of the acid from abroad, to be distributed at cost price to the local authorities. The first Russian orders for carbolic acid were placed in Germany; but as that country does not manufacture enough for its own needs, almost the whole of the increased demand will have to be supplied by makers in Great Britain. The weak point in the position of this article is that the demand

for it is limited to the summer months. Before the present agitation set in, carbolic acid of all descriptions was down to prices lower than had ever before been recorded; and several of the makers had ceased manufacturing it. A German firm of aniline-dye manufacturers a few years ago placed some synthetic carbolic acid upon the market; and this was at one time regarded as likely to become a serious competitor with coal-tar acid. But it is hardly heard of now; being dear, though good. Although the superiority of carbolic acid as a disinfectant has frequently been challenged, there is no doubt that it still holds the first place in popular favour; and no other disinfectant is so liable to sudden demand and rise in value. Carbolic acid has other uses, however; one of the principal being in the manufacture of high-power explosives—notably melinite. This is made with picric acid, about two-thirds of which is carbolic acid; and the quantity of this product thus absorbed by the French and German Governments has been enormous. Since 1890, however, the continental demand has fallen off. The same authority estimates the total quantity of coal tar converted into various commercial products at about 820,000 tons per annum, of which over 600,000 tons fall to the share of this country. Assuming that the production of carbolic acid is about one-twentieth part of the weight of the coal tar dealt with, its total output in Europe would be about 41,000 tons a year, of which some 30,000 tons are produced in this country.

The Testing and Manufacture of Cement.

It is remarked in *Industries* that the one burning question that is now occupying the attention of users and testers of Portland cement, is the adoption of some form of hot test. From all sides come news of experimental methods of cement testing, which, however they may differ in detail, are almost identical in principle. The new method of testing adopted by the Docks Department of New York consists in exposing pats of the neat cement about ½ inch thick to a steam-bath, at a temperature of from 195° to 200° Fahr., and then in water at the same temperature for different periods, and then comparing their behaviour with that of pats kept in water at the ordinary temperature, and in moist air. Another test is keeping the pat in boiling water for 24 or 48 hours, at the end of which time it is required that no cracks should appear at the edges—which are made thin, in order to increase the severity of the test. The use of boiling water in this way is condemned as being only a subterfuge for avoiding the trifling difficulty of maintaining water constantly at any other temperature, and has two notable disadvantages—first, of mechanically agitating the liquid; and, secondly, of changing its composition by concentration. The Deval process is considered to be well established, both by the work of its originator and by the subsequent experiments of those who have been wise enough to take it into use. It is remarked that the practice of aërating cement is only a makeshift to remedy, as far as possible, the results of careless manufacture, and should not be regarded as normal and inevitable. It is also stated to be impossible to overburn cement; and certain experiments in this direction are cited, to show that English-made cement should be harder burnt, which will necessitate the abandonment of the use of solid fuel, and the substitution for it either of liquid or gaseous fuel. The ash of the ordinary fuel—which is coke—is composed mainly of silica; and its presence, of course, deteriorates the cement. It is therefore concluded that the solid fuel should be gasified before coming into contact with the cement, the simplest way of doing which is to use the producer. It is indicated that, in the best interests of the English cement trade, continuous burning kilns with gaseous fuel must be adopted as speedily as possible.

Stockport Corporation Gas Committee.—Mr. Joseph Leigh, M.P., has resigned the office of Chairman of the Stockport Corporation Gas Committee. Mr. Noden has been appointed to succeed him.

A Long Gas-Lighted Road.—The Ashton-in-Makerfield Local Board have decided to erect gas-lamps on a hitherto unlighted portion of the highway running through their district. When this is done, it will be possible, it is said, for anyone to travel from Liverpool to Manchester by gas-lighted roads without a break.

The New Croton Dam of the New York Water-Works.—Towards the end of June last, tenders were submitted to the Aqueduct Commissioners for the construction of the new Croton Dam of the New York Water-Works. The offers were all rejected, because the Commissioners regarded the lowness of the lowest bid as "offset by the limited financial responsibility of the Corporation making it." Other tenders were afterwards sent in; and these were opened on the 24th ult. There were five in all—viz., Mr. J. S. Coleman, New York, $4,150,573; Mr. H. H. Brown, New York, $4,181,464; Mr. T. J. Sullivan, Albany (N.Y.), $4,314,865; Mr. J. M'Quade, New York, $4,403,800; Messrs. Winston, Crimmins, Washburn, and Co., $4,527,769. The bids submitted in June ranged from $3,527,640 to $5,549,998. The estimate made by the Chief Engineer (Mr. A. Fteley, M.Am.Soc.C.E.) was $4,574,820. The Commissioners held a special meeting on the 26th ult.; and the result of their deliberations was the placing of the contract with Mr. Coleman, the lowest tenderer.

COMMUNICATED ARTICLES.

OXYGEN PURIFICATION.

By H. Leicester Greville, F.I.C., &c., Chemist to the Commercial Gas Company.

The paper recently read by Mr. Stenhouse, before the Manchester District Institution of Gas Engineers, has brought the question of oxygen purification again to the front. Both the paper and its attendant discussion were interesting, in spite of the fact that the main point—viz., cost—was not settled. Even apart from the mere cost of this special process, there are so many details involved in the question of practical gas purification by various methods, that the whole subject is beset with many difficulties. Initially, there is a broad distinction between the action of oxygen or air in purification, inasmuch as the oxygen may be assumed to be totally absorbed in the process, and therefore cannot prejudicially affect the illuminating power, while (theoretically) the use of air is accompanied with a possible reduction in the lighting value of the gas, by reason of the diluent action of nitrogen. As a balance against this, it must be remembered that, while oxygen has to be specially manufactured at a price which it is difficult to fix definitely, air is obtained for nothing. A further curious factor is that, while the numerous advocates of the use of air all claim that it can be usefully employed within definite limits without any deterioration in the lighting value of the gas, the advocates of the oxygen process claim that a small proportion of free oxygen improves the illuminating power—a claim distinctly denied by Mr. Stenhouse, who says that "careful tests have been made at Rochdale with 18-candle gas—first without any added oxygen, and afterwards with amounts varying between 0·1 and 0·5 per cent.—but no increased illuminating power has been obtained."

With regard to the practical use of air or oxygen in purification, there is a great distinction to be drawn in connection with the purifying medium employed. With oxide, the question is simply one of revivification *in situ v.* the ordinary process; while with lime, there is the more complicated issue of considering the total duty of the lime used in the ordinary way, as against its use with a gas containing oxygen. In the latter case, the question is complex by reason of the chemical reactions involved. Where a gas company is not under statutory obligation to reduce the sulphur compounds, and uses oxide in order to eliminate sulphuretted hydrogen, and lime subsequently to remove carbonic acid, there is no doubt that the use of air or oxygen is an advantage in economizing labour. But I am strongly of opinion that the revivification of oxide *in situ* develops a considerable amount of back pressure which would place a veto on the employment of the process at any works where the purifying area was not abnormally great. I have visited works where the process has been used; and the spent oxide has had to be removed from the purifiers with a pickaxe, coming out in hard rock-like masses which must have developed a great resistance to the free passage of the gas.

That the nitrogen passing forward and mixing with the purified gas, where air purification is employed, has not been observed within certain limits to deleteriously affect the illuminating power, is certainly unexpected from a theoretical point of view; but I am still of opinion that the explanation of this phenomenon which I offered some years back is a true one—viz., the maintenance of an abnormally high temperature in the purifiers. The effect of this is to minimize the condensation and screening out of illuminating hydrocarbons, and to tend to their permanent retention in the gas passing forward. We have, I believe, in large masses of moist lime and oxide, constantly renewed, a more potent agent in condensing many hydrocarbons than is generally acknowledged; and a practical proof of their action in this respect would seem to be the comparatively long period during which the gas is lowered in illuminating power after a change of purifier has been made—longer than is accounted for by the mere mechanical admixture of a limited quantity of air. There is further proof in the persistent odour of the spent materials after withdrawal from the purifier—more persistent than can be accounted for by the mere occlusion of foul gas in the pores of the purifying mass.

Turning to some special points in Mr. Stenhouse's paper, and to some others elicited during the discussion, one of the most remarkable circumstances mentioned is that (in the original paper) "it is a common occurrence to find from 25 to 50 per cent. of the total oxygen added to the crude gas, pass through the whole of the lime boxes without reacting with the sulphuretted hydrogen, although from 300 to 400 grains of this gas per 100 cubic feet may be leaving the last of the three lime boxes." Knowing how rapidly the sulphur compounds of calcium oxidize on exposure to air, this testimony of results obtained in practical working is very curious. The area of the purifiers and the make of gas is not given; but possibly the velocity of the gas through the material was too great to allow the requisite time for the full chemical actions to take place. Otherwise, the reaction between free oxygen and sulphided lime must be one requiring considerable time for its full completion. It should, however, be noted that 300 *to* 400 *grains of sulphuretted hydrogen were leaving*

the last of the three lime boxes; and we may assume that the possible reactions between the oxygen and sulphuretted hydrogen were complete under the existing conditions, and that the 300 to 400 grains of sulphuretted hydrogen passing forward simply represented the result of the decomposition of sulphides by entering carbonic acid, in which case calcium carbonate would be in process of active formation, upon which free oxygen would have no action. Dr. Thorne, in the discussion on the paper, expressed surprise at sulpuretted hydrogen passing forward in conjunction with free oxygen; but we can only assume that the internal oxidation was of a limited character, and, owing to high velocity or some other conditions, not extending much beyond the formation of the higher calcium sulphides. Thus, if we assume that we get initially a large proportion of calcium sulphydrate ($Ca\,S,H_2\,S$) formed by the reaction

$$CaH_2O_2 + 2H_2S = CaS,H_2S, + 2H_2O,$$

by the advent of oxygen, we have a subsequent possible reaction

$$5CaS,H_2S + 8O = 2CaS_5 + 3CaH_2O_2 + 2H_2O$$

The CaS_5 (calcium pentasulphide) would be decomposable by carbonic acid, with formation of calcium carbonate, and liberation of free sulphur and sulphuretted hydrogen, thus—

$$CaS_5 + CO_2 + H_2O = CaCO_3 + H_2S + S_4$$

There is, of course, no doubt that higher oxidation products of sulphur and calcium are formed in limited quantity—such as hyposulphate, sulphite, and sulphate. But the main products of limited oxidation, arising from the use of a small proportion of air or oxygen, are probably the higher calcium sulphides $Ca\,S_2$ and $Ca\,S_5$; and it is no doubt these compounds that combine with carbon disulphide, and thus reduce the proportion of sulphur compounds in the gas.

Mr. Stenhouse speaks of the liquid draining from the purifiers, which "holds in solution a large amount of polysulphides of calcium dissolved out of the partly fouled lime." My experience is that similar liquids are always formed in ordinary working, even where oxygen or air is not intentionally added to the crude gas. A large quantity of liquid must be normally formed from the reaction between calcium hydrate and carbonic acid and sulphuretted hydrogen. Even with oxide, the conversion of ferric hydrate into sulphide is accompanied with the formation of water. The gas entering the purifiers is already saturated with water vapour; and therefore the water that is produced by chemical reaction cannot be taken up by the gas, but drains away from the purifying material, carrying with it a certain proportion of any soluble constituents. The liquid draining from active lime vessels, I have always found to be of a more or less pronounced yellow or orange colour, and also more or less charged with the polysulphides of calcium. This is no doubt a product of limited oxidation, arising mainly from the small proportion of air that is inevitably introduced into the gas every time a retort is drawn and charged.

A point of interest noted by Mr. Stenhouse in the use of oxygen purification is the large proportion of free lime present in the material as discharged from the purifiers, amounting to "about 15 per cent. of unaltered calcium oxide." Mr. Stenhouse attributes this to the crusting over of the material with various sulphides minimizing the proper contact with the foul gas. This theory is no doubt a partial explanation; but I am inclined to believe that temperature plays an important part in the matter. Where, in addition to the heat ordinarily developed from the combination of the calcium hydrate, and carbonic acid and sulphuretted hydrogen, there is the heat of oxidation by the action of oxygen, the gross temperature of the mass becomes abnormally high. This promotes a drying action on the bottom tiers of the material, and tends to minimize the action of the lime—dry calcium hydrate being practically inert on both carbonic acid and sulphuretted hydrogen. I remember once having some experience at a gas-works where the purification was at fault; and the mischief was eventually traced to an abnormal quantity of air, which was being drawn in through a leak in the hydraulic main. The temperature of the outlet gas on the A lime vessel frequently reached as much as 106° Fahr.; and the material on discharge was inefficiently saturated and came out in dry hard masses.

Before concluding the present article, I will make a brief allusion to two further points in the discussion on Mr. Stenhouse's paper which appear worthy of note. Mr. Carr alluded to the use of manganese oxides in the form of Weldon mud, which, with the process of "revivification *in situ*" by the use of air could (it was alleged) be charged with 50 per cent. of sulphur. I do not think there is any special virtue in the action of manganese oxide conveyed in this statement, as the same result has been claimed for good-class iron oxides employed under similar conditions. The further point to which I wish to make a brief allusion is with regard to the alleged effect of small proportions of free oxygen in raising the illuminating power of gas. Mr. Stenhouse said he did not observe any increase in the lighting value of gas with admixtures of from 0·1 to 0·5 per cent. of oxygen; while Dr. Thorne, although surprised at the result, appeared not to claim for the oxygen process that free oxygen would raise the illuminating power of purified gas, but that the use of the oxygen process, as applied to purification, resulted in an increase in the lighting value of the purified gas as compared with that obtained by the ordinary process. I do not doubt the latter proposition under certain conditions, and have already offered a probable explanation. It may also be probable that, under certain conditions, a small proportion of free oxygen might enhance the illuminating value of purified gas; but this would probably depend on the original lighting power of the gas, and the special conditions of testing—especially with regard to the burner employed.

With regard to the oxygen process of purification generally, its wider adoption must largely depend upon an actual demonstration of cost under varying conditions; but possibly the greatest bar to its progress will be the undisputed fact of so many works gaining many advantages of oxygen purification simply by the use of air, which is obtainable without cost.

COAL GAS: ITS MANUFACTURE, DISTRIBUTION, AND CONSUMPTION.

A Series of Articles for Gas Students.

(*Continued from p.* 467.)

The Testing of Gas.

In order that the efficiency of the methods and apparatus employed may be tested, and, moreover, that the manager may satisfactorily ascertain what provision he must make for further purification, it is usual to periodically test the gas on the outlet of the scrubber for approximately ascertaining the amount of impurities still present. Those that will most concern the manager at this stage will be ammonia, carbonic acid gas, and sulphuretted hydrogen. All three, together with bisulphide of carbon, have already been more or less reduced; the former having been almost, if not quite, removed.

Ammonia and sulphuretted hydrogen are readily tested for with moistened turmeric or reddened litmus and lead acetate papers respectively. If ammonia be present in even so small a quantity as one grain per 100 cubic feet of gas, it will discolour the turmeric paper (F. W. Hartley); if in large quantities, it will turn it a deep red colour, or reddened litmus paper blue. If sulphuretted hydrogen be present, it will discolour the white acetate paper—turning it brown with traces, or black with any quantity of the impurity. To test with these papers, it is only necessary to allow a jet of unlighted gas to impinge upon them for (say) from two to three minutes. To ensure their sensitiveness, they should themselves, when they indicate no impurity, be tested after use. The presence of carbonic acid is readily detected by passing the gas through a little lime-water, or a solution of barium hydrate, when a carbonate is readily formed and precipitated in the solution.

The foregoing are merely qualitative tests, indicating simply the presence of the various impurities in the gas. There are several methods in use for ascertaining quantitatively the amount of these impurities. By the kindness of Professor Wanklyn, the writer is at liberty to describe here the methods employed by him, as set forth in his "Gas Engineer's Chemical Manual," to which reference has been made in the course of these articles. A sample of the gas to be tested is collected by displacement in a Wanklyn gas-bottle. This bottle holds exactly 1-10th of a cubic foot, or 100 fluid ounces. It is provided with a hollow stopper which holds $2\frac{1}{2}$ fluid ounces, and is designed to contain the reagent, which may thus be brought into intimate contact with the gas. A graduated burette enables the operator to ascertain the exact quantity of the reagent used in the hollow stopper; and from this he judges as to the quantity of the impurity dealt with.

In testing for ammonia, the gas-bottle is first filled with gas by displacement. The hollow stopper is then inserted fully charged with distilled water, and the bottle well shaken up, so as to absorb all the ammonia present. The solution thus obtained is examined by the Nessler test, as in water analysis. This is a colour test. When a solution containing ammonia (whether free or as a salt) is added to the Nessler test solution —*i.e.*, an alkaline solution of iodide of mercury in iodide of potassium—a brownish colour is produced, the intensity of the colour depending upon the proportion of ammonia present, due to the formation of tetramercurammonium iodide, thus—

$$N\,H_3 + 2\,Hg\,I_2 = N\,Hg''_2\,I + 3\,H\,I.$$

A known quantity of the liquid under examination is placed in a glass cylinder, and to it is added (say) one cubic centimetre of the Nessler solution. The tint thus produced (if any) is compared to that produced in another cylinder, where to 1 cubic centimetre of the Nessler solution has been added a certain quantity of an ammoniacal solution of known strength. The liquid in this second cylinder is changed again and again; the quantity of Nessler solution remaining constant, the strength of the liquid as regards ammonia being varied until the tints in the two cylinders are alike. The proportion of ammonia present in the liquid of the second cylinder being accurately known, that in the liquid under examination is, of course, at once ascertained. This is the most delicate and accurate test known. It is capable of detecting 1 part of ammonia in 20,000,000 parts of water. (Thorpe.) The more ordinary test in a gas-works would be by neutralization with an acid of known strength. This will be fully dealt with later on.

In testing for sulphuretted hydrogen, the gas is collected as before in the Wanklyn bottle, and is washed by a definite quantity of lead acetate solution of known strength. The solution is

vigorously shaken up in the bottle, instantaneously taking up quantities of the impurity, as indicated by the sudden change of colour of the solution. A lead acetate paper is then inserted in the bottle. If the whole of the sulphuretted hydrogen has been absorbed, the paper will remain white. If more of the impurity still remains, the paper will be darkened, and the gas must be again washed with more solution. This process has to be repeated again and again until the acetate paper ceases to darken. The amount of solution used will then be read off, and the manipulator will at once know what amount of sulphuretted hydrogen there was present in the gas tested. The solution contains 20 grains of lead acetate to one pint of distilled water; and 1-16th of an ounce will precipitate 1-100th of a grain of sulphuretted hydrogen. The bottle containing 1-10th of a cubic foot, each 16th of an ounce employed with the bottle full of gas corresponds to 10 grains of sulphuretted hydrogen per 100 cubic feet of gas. A simple method of inserting the test-paper in the bottle is by placing the former on an ordinary plain wire paper file on a stand, with the point upwards, and which can be readily inserted in the bottle, and as readily withdrawn. In testing for carbonic acid, the bottle is filled by displacement as before. The stopper, full of a saturated solution of barium hydrate, is thoroughly shaken up in the bottle, and then allowed to completely settle. The precipitate is filtered off and dried; and, the filter being burned in a crucible, the resultant carbonate is weighed. The estimation of the amount present per 100 cubic feet of gas is then only a simple matter of calculation.

Harcourt's colour tests provide a ready means for estimating the amount of carbon bisulphide, carbonic acid gas, and sulphuretted hydrogen present in the gas at this stage. The apparatus employed consists of: (*a*) A stand comprising a small Argand burner and short glass chimney, with pipeclay cover (in two halves), and a glass bulb containing platinized pumice, fixed from ¾ inch to 1 inch above the flame of the burner. Inside the bulb is the gas-inlet tube, which passes nearly to the bottom, down through the platinized pumice, and terminates in a fine jet. A short tube blown into the upper part of the bulb provides the outlet, and carries the gas away to the test-glass. The gas supplies to the burner and bulb are regulated by separate taps. The burner and bulb are used for the carbon bisulphide test only; being utilized for the decomposition of this compound into sulphuretted hydrogen. (*b*) A light stand holding upright two test-glasses. One is hermetically sealed, and contains a solution of standard colour. [Two colour standards are supplied for the carbon bisulphide and sulphuretted hydrogen tests—one for use by daylight, the other by gaslight.] The other is an open glass, provided with a doubly perforated stopper, and designed to contain a definite quantity of a reagent of known strength. Two tubes are fitted into the stopper—the inlet-tube passing to nearly the bottom of the glass, and there terminating in a fine jet whence the gas bubbles up through the liquid in a very fine stream; and the outlet-tube, which just passes through the stopper to the inside of the test-glass, and is connected direct to (*c*), a metal, glass, or earthenware cylinder, having at the top a perforated stopper for the insertion of a glass inlet-tube, and a tap at the bottom. This cylinder is designed to act as an aspirator. (*d*) One or more graduated glass cylinders, into which the water from the aspirator is collected. The quantity of water run from the aspirator, of course, corresponds to the amount of gas by which it has therein been displaced, and which has passed through the test solution. The whole is suitably connected with india-rubber tubing; care being taken that all the connections are perfectly gas-tight. The instructions for using these tests are as follows.

For carbon bisulphide, the standard colour solution will be placed in the stand provided, and side by side with it the test-glass containing the specified quantity of lead syrup solution, of a known definite strength. Turn the gas on so as to pass through the bulb at the rate of about ½ cubic foot per hour. Light the ring burner, and allow it to burn with a small non-luminous flame. After blowing all the air out of the bulb, it may be connected with the test-glass, which is filled as required with the lead syrup solution. The outlet-tube of test-glass is then connected to the aspirator, which has previously been fully charged with water. The test-glass stand should have a white background, to facilitate the comparison of tints of the two liquids. The burner should be alight some few minutes before commencing to test the gas. When ready to test, the aspirator tap is turned on, and a gentle stream of water allowed to run into the graduated cylinder. Simultaneously the gas commences to bubble up through the lead solution on its way to take the place of the water from the aspirator. This will be continued until the lead solution assumes a colour of similar tint to the standard solution. When both are perfectly alike, the aspirator tap is closed, and the amount of water run into the cylinder read off. This will represent what amount of gas has been used to change the lead solution to the standard colour; and, on reference to printed tables provided with the apparatus, it will indicate the approximate amount of carbon bisulphide present in the gas. If the full amount of sulphur is to be ascertained, allowance must be made for certain compounds containing sulphur other than carbon bisulphide, and which are not indicated by this test. These have been roughly estimated at about 7 to 8 grains per 100 cubic feet of *purified* gas. As a matter of fact, this estimate is not to be relied upon, as at some works gas is constantly being sent out in which the *total* sulphur compounds do not, at times, exceed 6 grains per 100 cubic feet.

For the sulphuretted hydrogen test, the same procedure is followed, except that the heating of the gas prior to testing is unnecessary. The burner-stand is therefore dispensed with, and the gas is sent direct into the lead solution.

For the carbonic acid test, the gas is passed into a saturated solution of barium hydrate. The carbonic acid gas present immediately precipitates barium carbonate, thereby rendering the solution opaque. The standard liquid used for comparison contains a known quantity of barium carbonate in suspension; and the gas must be passed through the test solution until the opacity of the latter is equal to that of the standard liquid. The aspirator tap is then shut, and the amount of water in the cylinder read off. A reference to the printed tables gives the operator the percentage of the impurity present in the gas. Both the standard and test liquids should be repeatedly shaken during the progress of the test. The comparison of the liquids will be facilitated if the stand be provided with a black back-ground.

Folkard's test for carbonic acid gas is also ready and easy of application. It is a colour test, and is based on the fact that a solution of phenolphthalin

$$\left(C_{20}\ H_{14}\ O_4,\ \text{or}\ C_6\ H_4 \begin{matrix} CO - C_6\ H_4 - O\ H \\ CO - C_6\ H_4 - O\ H \end{matrix}\right)$$

is coloured pink by baryta water, but is colourless if only carbonate of baryta or acids are present (owing to its conversion into phenolphthalin

$$\left(C_{20}\ H_{16}\ O_4,\ \text{or}\ C_6\ H_4 \begin{matrix} C\ (OH) - C_6\ H_4 - O\ H \\ C\ (OH) - C_6\ H_4 - O\ H \end{matrix}\right)$$

The method of applying the test is as follows: A measured quantity of baryta water is coloured with a few drops of phenolphthalin. The exact quantity of acid required to decolour this solution is then ascertained. Another similar quantity of baryta water, also similarly coloured, is shaken up with a measured quantity of gas containing carbonic acid gas; and then a note is made of the quantity of acid required to decolour it. It is evident that the difference between the amount of acid required in the first case and the second must be due to the conversion, by the carbonic acid gas, of some of the barium hydrate into a carbonate, and the consequent partial decoloration of the phenolphthalin.

The Wanklyn bottle could with advantage be used with this test, although not specified by the makers, Messrs. Alex. Wright and Co., to whom the writer is indebted for some of the particulars here given.

The gas to be tested is previously freed from sulphuretted hydrogen (which would interfere with the acid reactions on the phenolphthalin) by passing through small experimental oxide purifiers. It is then collected, by displacement in a gas-bottle, into the stopper of which is inserted a burette or other vessel containing a definite quantity of baryta water of (just previously) ascertained strength. When the bottle is full of gas, the stopper is inserted, and the gas washed by the solution named. Whatever may be the amount of carbonic acid gas present, there must be an excess of barium hydrate; otherwise the later stages of the test will be a failure. When all traces of carbonic acid gas have been absorbed (a matter that the operator will soon readily decide for himself, after a little practice), the gas-bottle is held neck downwards, and the liquid drained from the burette into the bottle. A few drops of phenolphthalin are afterwards added. The acid measure is then filled, and the acid transferred to the bottle, drop by drop, until the colour disappears. The baryta measure, with the small quantity of baryta water still clinging to its sides, is replaced tightly in the neck of the bottle; and the now colourless liquid in the bottle is made to wash it out. The pink colour will be found to have reappeared (provided the acid has been added drop by drop); and more acid must be run into the gas-bottle by single drops until the colour again disappears. Any acid in the pipette (used for transferring the acid from the measure to the gas-bottle) is then blown back into the acid measure; a minute or less is allowed for it to drain down the sides, and the quantity used is noted. If it be the same as was required to neutralize the measured quantity of baryta water not used in the test, there could have been no carbonic acid in the gas. If the quantity be less, the difference will be noted, and the amount of carbonic acid present ascertained by calculation.

(To be continued.)

North of England Gas Managers' Association.—The half-yearly meeting of this Association will be held next Saturday at Seaham Harbour. In the notice referring thereto, the Secretary (Mr. W. Hardie, of Newcastle-on-Tyne) requests members to book to Ryhope by the North-Eastern Railway, where a special train will be in waiting on the Seaham line, to convey them, at 11.23 a.m., to the gas-works. After inspecting these, they will proceed in brakes to visit Seaham Hall. On returning, the meeting will, by permission of the Chairman and Directors, be held in the gas offices. The *agenda* includes an address by the President (Mr. J. Whyte); and papers by Mr. H. Tobey, of Malton, on "Notes of Asphalte Paving," and by Mr. T. Bower, of West Hartlepool, on "Tar as Fuel." Dinner is fixed for 2 p.m., at the Railway Station Hotel.

TECHNICAL RECORD.

EASTERN COUNTIES GAS MANAGERS' ASSOCIATION.

The Eighth Half-Yearly Meeting of this Association was held last Wednesday, at Lowestoft, under the presidency of Mr. C. E. Jones, Assoc.M.Inst.C.E. (Chesterfield). There was an exceptionally large gathering of members and friends; and the day's proceedings were of a very enjoyable character.

The members assembled at the Suffolk Arms Hotel at noon, where a liberal luncheon had been provided for them by the Directors of the Lowestoft Water and Gas Company. The Chairman (Mr. F. Morse) presided at the head of the table; and the vice-chair was occupied by the Engineer and Manager (Mr. J. Ayris). The Mayor (Mr. J. M. Bradbeer) also honoured the Association by his presence. Before quitting the table, the members, through the President, expressed their hearty appreciation of the excellent provision which the Directors of the Company had assisted in making for their entertainment.

The members then proceeded to the rooms of the Young Men's Christian Association, where the meeting was held.

The President, on taking the chair, asked to be permitted to thank the members for their kind indulgence to him on the occasion of their meeting at Sleaford, at which time he was in ill-health, and scarcely capable of performing his presidential functions. He also trusted that the meeting that day would end as pleasantly as it had begun.

Confirmation of Minutes.

The Hon. Secretary and Treasurer (Mr. H. Wimhurst, of Sleaford) submitted the minutes of the meeting held in March last at Sleaford; and they were confirmed.

Election of New Members.

The following gentlemen were elected members of the Association: Mr. A. G. Dow, of King's Lynn; Mr. J. B. Fenwick, of Retford; Mr. C. Green, of Market Rasen; Mr. W. D. Child, of Romford; and Mr. G. King, of Halesworth.

An Official Reception.

The Mayor said that, before the members proceeded further with the business, he should like to say that it afforded him considerable pleasure to have the opportunity of giving expression to a few words of welcome. He had been pleased to hear from the President that the members had been very kindly treated since they had been in Lowestoft; and, on the other hand, he (the Mayor) thought that the town was highly favoured by the Association paying it a visit. He hoped the paper and discussion which the members were about to have would be beneficial not only to the town, but to the gas industry at large.

The President, on behalf of the members, thanked the Mayor for the reception which he had extended to them. He assured him that they highly appreciated the kindness of the people of Lowestoft; and he hoped the time was not far distant when they would pay the town another visit.

Letters of Apology.

The Hon. Secretary intimated that he had received letters of apology from several gentlemen who were unable to attend—among them being Mr. W. A. Valon, of Ramsgate, Mr. J. Hepworth, of Carlisle, Mr. John West, of Manchester, and Mr. J. S. Allerton, the Secretary of the Lowestoft Water and Gas Company.

Mr. W. J. Carpenter (Great Yarmouth) then read the following paper:—

CARBONIZING METHODS, PAST AND PRESENT.

In selecting this subject for the remarks I am about to make, it occurred to my mind that we in the Eastern Counties might do well to discuss and to carefully consider the whole question, with a view to more economical working, and moreover to possess ourselves of the condition of things happening in and around these important matters. The question of carbonizing—comprising as it does the primary points in gas manufacture—demands that we should do our utmost to take advantage of any inprovement which may present itself, and which has for its object the cheapening of production, and the protection of the men employed in the arduous task of stoking.

On reference to the earlier days of gas manufacture, we find repeated instances of men's minds being directed to the development and improvement of carbonizing schemes—not only so far as the placing of the coal into the retort, and the subsequent removal of the coke, but also with reference to the details in connection with retort-setting, the arrangement of the benches, and last, but not least, the section of retort and the means of heating to be employed. The result of these early efforts—supplemented from time to time by most important improvements, by many clever engineers who have closely followed the subject—has been of a highly gratifying order; inasmuch that we have now plant and arrangements within our grasp, by which we are enabled to deal with varied kinds of coal and cannel so satisfactorily as to extract every foot of illuminating gas available—thereby economizing greatly as regards raw material.

The subject of high and low heats I take as fairly well thrashed out, and that the former consistently employed are, no doubt, most popular among engineers. In my experience, systems which lend themselves to irregular heating, cause much anxiety, not to say considerable trouble, consequent bad working, and monetary loss. It will probably be said that, with high heats, the gain aimed at is counterbalanced by the amount of difficulty found in keeping the ascension and dip pipes free from pitch deposits; and I am conscious that care has to be exercised in dealing with some kinds of material. But given proper attention, we are enabled to make a more permanent gas by employing regularly high heats, and making the charges of coal as heavy as possible, in preference to encouraging any inclination on the part of the men to charge lightly.

The form of setting still varies very much in accordance with usage and local requirements. But in medium-sized provincial works, the setting of six ⌂ retorts is more generally adopted than any other plan; and, in most instances where the charging and drawing are effected without stage-flooring, it is in many ways a convenient and economical setting. Engineers differ, too, as to the size of the retorts employed, and produce results against results in favour of one or the other idea. My own experience compels me to say that, for works employing the old system of hand labour (viz., scoop charging and hand drawing), care should be exercised in order that the retorts are not too large. A medium size is preferable, as it facilitates the work, the men not being exposed so much to the heat; and the make per mouthpiece, taken on the average, will compare with the large sections under these conditions.

The method of heating gas-retorts, having regard to regularity, effectiveness, and thorough economical working, is still a point upon which one might be excused for saying a few words. We are told that regenerator furnaces—entailing, as they certainly do, such extraordinary and costly alterations to existing works—prevent waste to such an extent that they readily repay their cost. Various companies and corporations were prevailed upon to apply the different systems in building new works; and trials have been made and, I believe, are being continued in this important direction.

The generator furnace has apparently outstripped the former; and when last I heard of results, and saw the working—viz., the working at the East Greenwich Gas-Works—my mind was impressed with the sound improvement made. I have tried generator furnaces with great success, although handicapped by being unable to obtain all the advantages by reason of our experiments being carried out with existing benches. Nevertheless, I have settings now at work which have been in operation over 1000 days—a record not to be obtained by the ordinary or direct fire. I, however, manufacture most of our gas by means of the direct fire; and the results are exceedingly good by these means. Several other works I know, where splendid results are obtained, use direct fires, and get paid for a quantity of gas per ton which points to good working beyond doubt. I find, however, that the wear and tear of furnaces and retorts is great compared with generator furnaces.

Now having gone so far as this, which brings us to the fact that the retorts and settings are capable of receiving and dealing with the raw material in a complete manner, I propose to move on to the methods of manipulation which have been such an all-consuming study to so many of our mechanical engineers. From the earliest plans and ideas we have as history down to this year, (I purpose commencing my remarks from 1878), there was without exception, a great endeavour to produce some means whereby the heavy retort-house work should be effected by mechanical means; and the various inventors appear to have agreed that such mechanical means should be, if possible, automatic in their action.

In 1878 a continuous automatic gas-making apparatus was patented. A paper upon this was read at the British Association of Gas Managers in that year. In order to illustrate the idea, I have obtained the model, and will endeavour to briefly describe the inventor's ideas and difficulties, and trust it may be interesting to those present. The model illustrates the plant as erected and worked under the inventor's supervision; the retorts being inclined, and the carbonizing chamber being common to both sides of the setting. The idea generally was to gradually and continuously carbonize the coal by receiving the same on screws of large pitch, and thrusting it down the inclined retort until the coke would fall into the carbonizing chamber; such carbonizing chamber being considered necessary, in order to prevent any coal passing away in the coke without being fully treated. This was carefully carried out; and gas was produced in large volume per mouthpiece—one of the experiments lasting a month without stopping the apparatus. The coke was splendid, and economical views were satisfied on all sides. Constructional cost was considered to be an overwhelming difficulty in supporting this scheme; and although the apparatus handled the coal automatically, and the coke was precipitated into a barrow below, no move was made towards trying the idea on a large scale. But the latter-day experience of huge strikes and labour organization has had the effect of widening our views upon endeavours in this direction; and I may be pardoned for giving an opinion that this apparatus is nearer perfection than any other form of inclined retorts introduced.

At the same time machinery was being produced, and the production has gone on, I am glad and pleased to acknowledge, with such admirable courage and skill that it is now possible to completely and successfully manipulate the most difficult and

varied kinds of coal and cannel, and to effect a real economy in the working. The model illustrates the manual machine invented by Mr. John West, who has been perhaps the most assiduous and successful engineer to grapple with the many difficulties and prejudices surrounding the introduction of labour-saving appliances. The machines are in ample evidence in works in the United Kingdom and abroad. Mr. West's idea, throughout his career, has consistently been that of an even charge of coal, properly and surely distributed in the retort. It has been to him a paramount consideration; and the machine as in the model can be thoroughly relied upon to carry out all required of it when seen in practical operation in either large, medium, or small works.

The mode of operation in this system is to crush and elevate the coals, and store a sufficient supply in overhead hoppers. The travelling machine and hopper take the required quantity from time to time from the store hopper, and are then propelled into position in front of the retorts to be charged. The small charger, having been filled by a revolving arrangement of feeder, is pushed into the retort, and, by turning the handle, the coal is deposited and levelled, presenting, when seen in the form of coke at the end of the charge, a perfectly even layer. Thus each superficial foot of the retort-floor receives its regular work each time it is charged, and methodical working is guaranteed. The discharging is accomplished by means of the travelling hand rake as illustrated. The cost of production by these machines, after taking into consideration wear and tear and contingent charges, may be fairly taken as showing a reduction over that of ordinary work of 1s. per ton of coal carbonized. The retort-house arrangements need, however, to be made complete, in order that the whole of the advantages may be derived. The machines produced by Mr. John West also include those actuated by compressed air, and wire-rope systems. The ingenuity displayed in their construction points to the masterly appreciation and knowledge of minute detail so apparent in all his work; and I am assured the gas profession has much to thank this gentleman for—his efforts being untiring.

With the advent of labour difficulties, the subject of automatic appliances received renewed consideration, and systems of inclined retorts were experimented upon with admirable vigour. The most recent development of the inclined retort system has met with more or less success, if we may take the public utterances of engineers who have experimented with them, to be a criterion. In this system the coal has to be elevated, placed into charging hoppers and shoots, and conveyed into the retorts ready for carbonization. When carbonized, the coke resulting is allowed to fall out by opening the lower doors; and the retort is again closed ready for a fresh charge. Machinery of a more or less elaborate character has been brought into use, in order to promote an even layer of coal in the retort (without an even layer proper carbonizing is impossible). I am not prepared to state from experience as to the success or otherwise of this system; but these are difficulties which appeal to my mind as being insurmountable under the conditions: The coal is naturally likely to deposit in a thicker layer at the bottom end of the retort than at the top; and condensation going on near this end (increasing the difficulty) must be likely to render the coke spongy, and a waste of tar occurs, beside being likely to make the work irregular. Moreover, I am of opinion that, if we must have machinery actuated as in the case of some of the inclined systems, not automatically, then we had better not change our mode of setting.

In my experience, following experiments, machine charging and drawing can be properly effected in horizontal retorts, and only improperly effected in inclined ones. It is regular and systematic working which tells in the end, and which is necessary above everything in a retort-house; and this must be brought home to most men when witnessing the work of the West machines in houses where arrangements have been properly made to receive them.

As regards the general question, I am satisfied to make that of discharging the retort a secondary consideration. The charging must be right to economize; hence in my idea the machines and horizontal retorts will bear comparison with the best work it has been my fortune to witness.

I hope the few remarks I have made will lead to a discussion which may tend to cheapen production in our works. Our aim should be strict economy; and provided adequate means are available, we must be at fault if we do not embrace them.

Mr. Carpenter had on view models of retort-charging machinery and two diagrams—one showing Mr. W. T. Carpenter's patent continuous carbonizing apparatus, and the other the most recent development of the inclined retort system. Referring to the latter, he said that one of the objections he had to the system was that the gas was taken from the bottom of the retort; while, in his opinion, it should be drawn off at the top. Then again, if the coal was not quite burnt off, the coke would not fall out so readily as was claimed. By the aid of a model, he then showed the action of a machine which had been invented to draw and charge a retort simultaneously. The charge of coal, he explained, was contained in two tubes, underneath which was the rake. During the passage of the tubes into the retort, the head of the rake was kept level with the tubes; but, on reaching the end of the retort, it dropped. On withdrawing the tubes, the rake forced out the spent charge, and at the same time the coal in the tubes was deposited in the retort. This model, Mr. Carpenter said, had been in existence for a number of years; but the idea had not yet been tried in actual working.

Discussion.

Mr. W. Barratt (Grantham) said he had spent some time in visiting different places to see the system of inclined retorts in action. It was true there were some things that might be said in favour of these retorts; but, as at present worked, a great many things might be said against them. The first objection he had to them was this: In one very extensive gas-works which he visited, he found the retorts were set back to back; and consequently they had two shoots—one to the right and the other to the left. In charging the retorts, he found it was necessary for a man to stand at the back and continually shake the shoot, in order to get the coal down at all, as, in coming from the hopper, it choked at the bottom. He next found that the coal was not deposited regularly in the retorts. To overcome this, some gentleman had invented a kind of grid, with a flange at the end to prevent the coal going too far down. Then, when the door was opened at the lower end, the coke did not run out at all. The coal was quite black at the bottom; and a man had to use a drag (the same as with the horizontal system) to draw out the coke. With this system, the heat, too, was something intense; and he really did not know how the poor attendants could stand the work they had to do. The Chairman of his Company accompanied him on his visit to the works in question; and he was very eager to learn all he could about the system—the result being that the heat affected his head and face fearfully. This occurred six months ago; and his face had since been skinned over and over again. With regard to the results realized by inclined retorts, so far as he could ascertain, they were very little better than were obtained from retorts set level—in fact, he had compared the figures which were given him with his own work; and he could not find any advantage from using inclined retorts in place of horizontal ones if properly worked. As to West's machinery, every gas manager owed a debt of gratitude to the inventor for the way in which he had stepped up to something like perfection in machinery to take the place of manual labour in the retort-house. The labour market had of late been in a very agitated state; and they all knew how difficult it was to get gas stokers to perform their duty as they ought to do. So that it was necessary gas companies should look to machinery for help. There was another matter to which he wished to refer. He had no sympathy with those who cried out about choked ascension-pipes. If the retorts were set as they should be, they might work with heats as high as they chose, and should have but few stopped pipes, providing they were fixed as they ought to be, and were of proper dimensions. He had been twenty years in his present position, and during that period had not had twenty choked pipes. He did not say that he worked at higher heats than anyone else; but his results would compare with those obtained by most gentlemen in his position. His retorts were 20 in. by 15 in. at the bottom, and 18 in. by 15 in. at the top, and he set seven in a bed; and if other managers set their retorts in this way, and kept their heats as high as he did, their working would be equally as good. He might say here that he paid his men by results—so much for every 1000 cubic feet of gas that passed through the station meter. The state of the meter was taken at six in the morning and six at night; and the men were perfectly satisfied with what they earned. Reverting to the question of inclined retorts, he said they would have to be improved a great deal before they were generally adopted. He was confident that there would be difficulties in discharging them—that the sides would become rugged with carbon, which would prevent the coke dropping out in the way in which it was supposed it would.

Mr. F. Weller (Southtown, Yarmouth), referring to the model of the machine described by Mr. Carpenter for drawing and charging retorts simultaneously, said he thought it would be a very suitable arrangement for use in small works. What they wanted in the retort-houses of small works like his was an improvement which could be adopted without great expense; and he wished that gentlemen connected with large works would take the matter in hand, and endeavour to show them some means of obtaining what they required. A year ago, at the Cambridge meeting, he read a paper in which he referred to the secondary air supply to his furnaces; but he should like something better than that. In small works, they had not room in the retort-houses for West's machinery.

Mr. J. E. Buckle (Woodbridge) also referred to the model of the machine for drawing and charging simultaneously; but he questioned whether the rake would draw all the coke from the back of the retort. As to the inclined retort system, he said they had no information as to its first cost, which, he understood, was enormous. If this was so, and they could not, under that system, produce more than from 10,200 to 10,500 cubic feet per ton of coal carbonized, he did not see that small works would obtain any advantage by adopting the system. He had seen a paragraph in the Journal of Gas Lighting in which it was stated that the Engineer of the Middlesbrough Gas-Works had produced, with retorts measuring 24 by 15 in. by 20 feet long, 20,000 cubic feet of gas in twenty-four hours. This meant a ton of coal every twelve hours; and he questioned whether it could be done. [Mr. Wimhurst: With three-hour charges.] He

doubted whether even then it could be done. In his own case, he produced 10,250 cubic feet; and he did not think small works could do better than that. He was also of opinion that horizontal retorts would last much longer than the inclined ones.

Mr. W. D. CHILD (Romford) said that he had recently been engaged on some extensions; but, before commencing them, he turned his attention to the various systems of carbonization, in order that he might select the best. His choice at last rested between inclined retorts and West's machinery. Mr. Carpenter, in his paper, said that he was satisfied to make the discharging of the retort a secondary consideration; but he did not quite agree with him. He (Mr. Child) saw the inclined retorts in operation in several works; and he noticed that two or three rakings were needed to get out the coke. But with West's machinery, the charges of coal were laid beautifully level; and they not only obtained the best results from the coal, but they were able to draw out the coke with the least possible exertion. Any man, he added, could be drilled to work the machinery in a couple of days.

Mr. B. GIBSON (Haverhill), alluding to the continuous gas-making apparatus that was described by Mr. Carpenter, inquired whether the coke produced was fit for anything but the "manure heap." Then, as to West's machinery, the author of the paper seemed to be very much taken up with it; but he had seen it at work both in the north and south, and did not care about it. With Atterton's machine they could charge a retort in two minutes; and, in his opinion, it was better done than with West's.

Mr. T. H. MARTIN (New Barnet) having alluded in complimentary terms to what Mr. Carpenter had done in improving retort-house work, said he somewhat differed from him in his recommendation of settings of six retorts for medium-sized provincial works, because, with the same expenditure of coke for firing, they could use a seventh retort. This was the system on which he set his retorts; and they were charged by hand, and fired in the ordinary way. The retorts were 21 in. by 15 in. by 8 ft. 6 in. (internal dimensions); and they gave very good results. With reference to the inclined retorts, he wished the author of the paper had given them a few more details. He did not know whether Mr. Carpenter had had any experience with them at Yarmouth; but he believed his father had an inclined retort of his own, which was not altogether a success. If all they read concerning the improved system of inclined retorts was correct, they were evidently now coming more to the front. The retorts which he had seen were not the same as had been referred to. Those he saw were at Brentford. They were charged from the top; but had no arrangement such as had been described for letting the coal down into the retort. One matter which had exercised his mind somewhat was this: That after a retort had been set for a time, there was a certain amount of sag, which might not be due to bad setting, but to the heats getting a little too high (he did not know whether the regenerative system would overcome this). Supposing, however, that these inclined retorts sagged in this way, he thought there would be great difficulty in getting the coke out. It appeared to him that, with the stop at the bottom of the retorts, there was a certain amount of waste, and that it might be shortened if the temperature were high enough to carbonize the coal at that point. He was a thorough believer in high heats; but there was one thing connected with this which he should like to mention. It was this: That, although one man might perhaps realize from 5000 to 6000 cubic feet per mouthpiece, it did not follow that another who had obtained a lower yield, working with the same size retort and at the same heats, was not doing well, because there was the quality of the coal he was carbonizing to be taken into consideration. A man might perhaps be able to purchase a cheap local coal, and at the end of the half year the results obtained by him, having regard to the price of the coal, would be equal to, if not better than, those realized by the man who used dearer coal.

Mr. MAURICE GRAHAM (the Engineer of the Automatic Coal Gas Retort Company), was invited by the President to address the meeting on the inclined system. In response, he said, with regard to the question of the distribution of the coal in the retort, that what was known as the Brentford shoot was the one which was now used, and this was found to work very satisfactorily. The Coze shoot, which was at work at the Southall Gas-Works, had been done away with. The coal in passing down from one hopper to the other was checked in its speed, first by the check on the scoop, and then by the one on the mouth; and, by these means, they obtained an even distribution of coal throughout the retort. One gentleman had referred to a case in which he saw a bad shoot in connection with a setting of inclined retorts; but all it was necessary for him to say in reference to this was that, as gas managers were well aware, they obtained at times bad machinery everywhere. With regard to the ascension-pipes, there was a difference of opinion among gas engineers on this point; and the consequence was that they had it their own way—some placing them at the top, while others preferred them at the bottom. The stop on the retort was at the end of the division wall; so that they obtained a good heat there. As to the spongy matter which was mentioned by Mr. Carpenter, he did not think they would find that unless the heats were low; in works where good furnaces were provided, they did not find it. With reference to the carbon in the retort, that could soon be burnt out by opening the top and bottom lids. Another point in favour of this system was that no skilled stokers were needed; they simply required a yard-man as an attendant. Regarding the cost of inclined retorts, this varied according to the locality from which the material was procured. The average cost, with 15 feet length of retort, was £42 per mouthpiece. The cost with the charger (which would deal with seven or eight beds) was £50. These had been adopted in several gas-works; and no inconvenience had been found in charging the retort. If the previous charge was well burnt off, it could be readily drawn, providing the angle which his Company suggested (32°) was adopted. In every case where the outside pattern of shoot (Morris and Van Vestraut's patent) had been adopted, the results obtained by the system had been good. Concerning the reference which had been made to the working at the Middlesbrough Gas-Works, he should like to say that the Engineer worked four-hour charges; and therefore he obtained the excellent results which had been mentioned.

Mr. CARPENTER, in replying upon the discussion, said he did not think the inclined retorts which Mr. Barratt had referred to were the improved ones; and, if he was not mistaken, those he had seen were at the Kensal Green Gas-Works. With reference to Mr. Buckle's remarks, the model of the charging and drawing machine which he had shown had not been out of its box before for a long time, and anyone who liked the idea was quite welcome to it. As to the coke produced by the continuous gas-making apparatus, Mr. Gibson had asked whether it was fit for the manure heap, or otherwise. After his (Mr. Carpenter's) long experience in carbonizing matters, it was not necessary for him to assure the members that he should not talk about a thing which produced coke only fit to be put on a manure heap. [Mr. GIBSON: I was thinking of Mr. Gilchrist's apparatus.] Mr. Gibson also said that he (Mr. Carpenter) was eaten up by Mr. West. He was brought up with that gentleman; and he believed his experience and ideas were good enough for him to copy. Mr. Child had made some remarks as to the discharging of retorts. He (the speaker) had said that he made it a secondary consideration; while Mr. Child intimated that he made it the primary consideration in ordering West's machinery. He quite agreed with him. West's machinery both charged and discharged the retorts properly; but if they charged their retorts wrongly, then it was no use grumbling about the discharging machinery. As to the number of retorts in a bed, he had always found six to be the best; his experience being that, if they had a retort in the centre, it was eventually burnt down. As to the inclined system, he did not think it was any cheaper than other systems of carbonizing. [Mr. GRAHAM: It is per ton of coal carbonized.] However, he should be very pleased to see inclined retorts come to the front; as this was a pet scheme of his. With the strikes and labour questions which were continually cropping up, he believed that they would have to look in the future for assistance to the inclined or some other improved method of working.

The PRESIDENT remarked that there was no doubt the question of inclined retorts and improved methods of carbonization would largely occupy the attention of gas engineers in the future; and whatever improvements were made in retort-house work, must of necessity be of advantage to the gas industry generally. He moved a vote of thanks to Mr. Carpenter for his suggestive and excellent paper.

The motion was heartily agreed to.

ELECTION OF OFFICE-BEARERS.

The PRESIDENT observed that the next business was the election of office-bearers. The Committee had selected a gentleman as President who would do honour to the position, and who would carry with him the highest respect of every member of the Association. He had considerable satisfaction in proposing that Mr. W. Duesbury, of Cambridge, be elected President for the ensuing year.

Mr. J. BARTON (Peterborough) seconded the motion, which was carried unanimously.

On the proposition of Mr. WELLER, seconded by Mr. BARRATT, Mr. Carpenter was elected to the post of Vice-President.

The Honorary Secretary and Treasurer (Mr. H. Wimhurst) and the Auditors (Messrs. Weller and Yorston) having been re-appointed,

The next business was the election of two members to serve on the Committee in place of Messrs. E. J. Brockway and A. Mitchell, who retired by rotation; and Mr. T. H. Martin was appointed, on the motion of Mr. CHILD, seconded by Mr. J. H. TROUGHTON (Newmarket), and Mr. A. Drage, on the proposition of Mr. HAWKINS, seconded by Mr. WELLER. Mr. W. J. Wells (Stamford) was selected to fill the seat rendered vacant by Mr. Carpenter's elevation to the vice-presidency.

THE NEXT MEETING.

On the motion of Mr. DUESBURY, seconded by Mr. C. G. GRIMWOOD (Sudbury), it was agreed that the spring meeting should be held at Cambridge.

A VOTE OF THANKS.

Mr. W. P. BROWN (Southtown, Yarmouth) then proposed a resolution, thanking the President and the other officers of the Association for their services during the past year.

Mr. MARTIN seconded the proposition, which was heartily agreed to.

The PRESIDENT, on behalf of himself and colleagues, thanked the members for their kind expression of approbation.

This concluded the business on the *agenda*.

VISIT TO THE GAS AND WATER WORKS.

The members were then conveyed by brakes to the gas-works, round which they were conducted by Mr. Ayris, the Company's Engineer. Everything bore a most orderly appearance; and some of the plant looked comparatively new. In the retort-house, there are 80 ⌂ retorts, from which something like 50 million cubic feet of gas are produced per annum. There are two gasholders (both erected in iron tanks above ground)—one being a two-lift of about 160,000 cubic feet capacity, and the other a single-lift of about 80,000 feet capacity. The purifiers, of which there are four, are 12 feet square; and only lime is employed in them. Mr. Ayris has one of Messrs. Kirkham, Hulett, and Chandler's "Standard" washer-scrubbers in operation (capable of dealing with 500,000 cubic feet of gas per 24 hours); and of the working of this machine, he spoke very highly. Time only permitted of a hasty inspection of the plant; and the members soon found themselves travelling through some beautiful scenery to the water-works at Lound. On arriving there, they were shown over the place by Mr. Ayris and the Superintendent (Mr. G. Chaston). The principal engine in use is one by Messrs. Marshall, Sons, and Co., of Gainsborough. It is of 35-horse power; but is only used when there is a heavy demand for water. At the time of the visit, there were at work two of Easton and Amos's old grasshopper beam-engines of 15-horse power; and some of the members were very interested in examining their action. The source of the water supply is a large lake near at hand; and the water, before being pumped to the town, is passed through three of the four filter-beds which the Company possess, and which each contain 14 feet of filtering material. It has been found necessary to make some additions to the works; and last week two new boilers were being placed in position.

The party reached Lowestoft again just before six o'clock; and, immediately afterwards, they dined together at the Suffolk Arms Hotel. The Mayor and other prominent local gentlemen were present; and a very pleasant evening was spent.

THE DEVELOPMENT OF GAS LIGHTING IN TRAINS.

At the recent meeting of the South-West of England District Association of Gas Managers, owing to Mr. E. C. Riley having to leave hurriedly to catch a train, he was unable to adequately reply to the discussion on his paper dealing with the above subject (see *ante*, p. 511). In order to complete the matter, he has prepared the following supplementary remarks for publication:—

In reply to Mr. Humphrys's question as to the effect of the regenerative action in the lamp on the illuminating power of the gas, I am unable to give any particulars, as the tests were taken with the burner alone fixed on the photometer, without the lamp, so that the illuminating power given is without the assistance of the regenerative action or reflector, both of which are important in respect to the actual lighting of the carriage, but the effect of which I have not been able to gauge. With reference to the variations in the results of compression, I would point out that all the tests taken on March 16, 18, and 21 were practically with the same gas, which was originally compressed to 150 lbs. (10 atmospheres) in a 10-foot cylinder, and reduced as required to the pressures at which the tests were taken. It appeared to me that some process of stratification took place in the cylinder, as in the series taken on each day the first was always the highest, each following test being lower; showing that the gas containing the richest hydrocarbons came off in every case first, except when the cylinder pressure got down to 5 lbs., and the gas again picked up the hydrocarbons thrown down in liquid form. As to the use of coal gas, I am of opinion that in many cases the use of coal gas for train lighting might very advantageously be extended, both compressed and uncompressed, according to local circumstances, especially with short-journey and made-up trains.

AMMONIA FROM BLAST-FURNACES.

Sir Lowthian Bell's Iron and Steel Institute Paper.

At the Autumn Meeting of the Iron and Steel Institute at Liverpool last week, Sir I. Lowthian Bell read a paper entitled "The Manufacture of Iron in its Relations with Agriculture," in the course of which he went very fully into the fundamental principles upon which plant life and animal life are built up. From an engineering point of view, however, the chief interest of the paper rested in a description of the plant by which certain bye-products are extracted from the fumes of furnaces using raw coal.

After a brief introduction, the author said: The two ingredients which enter into the composition of all animals, and therefore into that of the vegetables upon which they feed, and which concern us at present, are nitrogen and phosphorus; and it is to these that the remainder of my paper will be exclusively directed. Although the former constitutes fully three-fourths of the air we breathe, it is generally considered that neither vegetable nor animal is able to assimilate by direct absorption any atmospheric nitrogen. Such at least was the doctrine taught by Liebig, who believed that ammonia or its compounds were the vehicles which conveyed this form of nourishment through the vegetable to the animal world. As in the case of carbon, so with ammonia; for we have also to look to the atmosphere for our original supply of ammonia, in which, however, it exists in such small quantity—one part in one million of air—that Liebig himself estimated that, if it were all collected at sea-level, and had a density corresponding to the atmospheric pressure there, it would form a stratum less than ¼ inch in depth. This ammoniacal nitrogen, partly in the form of nitrite or nitrate or carbonate, is brought down by rain and received into the plant through its roots from the soil. This means decomposition of the alkali into nitrogen and hydrogen; and although fresh ammonia is generated by vegetables and animals during their decay, in a densely-populated country like ours, and with our sanitary arrangements upon their present footing, the waste of assimilable nitrogen is enormous, and appears to require being compensated from other sources than those which have been just enumerated.

This alkali is put to other purposes than the stimulation of vegetable life; but that obtained from the atmosphere is extremely diluted, and consequently unfit for any use in the arts. A very small quantity, and very irregular in its occurrence in the form of sal-ammoniac, is occasionally met with in volcanic regions. Chaptal, the French chemist, who wrote near the end of the last century, states that all the sal-ammoniac then required in commerce was made in Egypt from the distillation of camels' dung with common salt; the fuel used being the dung after being dried. Animal matters were also exposed at a subsequent date to a high temperature in this country, and the resulting ammonia collected and supplied, of course, at very high price. So late as a quarter of a century ago, it was sold at £30 per ton; the value now being probably only half of this. It is clear that all of these processes must have been attended with considerable expense, quite incompatible with its use as a medium for enriching the soil.

If we descend through the crust of the earth until we reach those subterranean forests in the form of coal, and if we examine the composition, we find that countless ages ago nitrogen was assimilated by vegetation as it is at the present day, and is to be found in pretty much the same quantity as exists in the plants growing in our own time. When fossil coal is burnt in an open fire, all the hydrogen it contains, including that in the ammonia, is converted into water, leaving the combined nitrogen probably to escape as such, with the formation of little or no ammonia. If, however, the coal is heated in a closed vessel air being excluded, the volatile carbon and its associated hydrogen escape, as tarry matter, and the nitrogen taking up hydrogen is carried over in the form of the precious ammoniacal alkali so much wanted.

Coal, however, up to the earlier part of the present century was rarely submitted to the distillatory process just referred to. After this, it occurred to Mr. Murdoch, exactly 100 years ago, to light his house by gas so obtained. The discovery, however, made such slow progress that, when I went to Paris 35 years after Murdoch's application of coal gas for illuminating purposes, the Rue Rivoli was, I believe, the only street lighted by its means. At the present day not less than 7 million tons of coal are used in the public gas-works of the United Kingdom alone. During the process of distilling gas a considerable quantity of tarry substances comes over, and along with it a certain amount of watery matter. The former, known as coal tar, for many years in my life was burnt or run away; and all the watery portion, containing the nitrogen in the form of ammonia, found its way also into the drains which led to the rivers. Chemistry afterwards opened out extensive fields for the utilization of the liquid tarry hydrocarbon; and the ammonia for some years past has been converted into sulphate, and handed over to the husbandman as a source of nitrogen for his growing crops. If all the coal treated in our gas-works is made to yield its ammonia, more than 60,000 tons of the sulphate must be produced—worth, at less than half its former price, about £600,000 a year. To this sum has to be added the tar, of which I shall speak hereafter.

I suppose that we are within the mark in saying that more than 15 million tons of coal are annually coked for the use of our iron-works. The whole of this is effected in ovens where the gas is burnt under conditions which preclude the possibility of any tar or ammonia being rendered available. My firm were early adventurers in the field for avoiding this terrible waste in this country. The coal was placed in ovens, which were virtually retorts. The gas evolved during the process was passed through a series of condensers, which intercepted the tar and ammoniacal solution; and the gaseous hydrocarbons thus purified were used for heating the ovens. Coke so made, however, was found less suitable for blast-furnace work than that obtained by direct application of heat to the surface of the coal; and the plan, to our disappointment and regret, was abandoned. Thus an annual loss of sulphate of ammonia is incurred worth considerably above a million sterling. From both these sources of ammonia—gas-works and coke-ovens—9000 to 10,000 cubic feet

of gas is obtained, and a quantity of sulphate represented by something under 5 lbs. of ammoniacal gas.

Of the pig-iron produced in Great Britain, about one million tons are obtained by the use of raw coal, of which about two tons are required per ton of metal, capable of furnishing about 17,000 tons annually of sulphate of ammonia. The success which had attended the extraction of ammonia from the gas made for illuminating purposes led the Scotch ironmasters to consider the feasibility of applying condensers to the gases as they leave their blast-furnaces. In the blast-furnace, however, not only are the 10,000 cubic feet of hydrocarbons to be gasified, but all the fixed carbon, save the small quantity which enters into combination with the iron, escapes as carbonic oxide or carbonic acid. In addition to this, we have the carbonic acid of the flux and the nitrogen of the blast, which more than doubles the volume of the gases; so that the ammoniacal gas rarely exceeds $\frac{1}{800}$ of the total, and is generally considerably less even than this. The lowest consumption of raw bituminous coal per ton of iron made I have ever heard of, is a trifle above 31 cwt.; but it often exceeds 40 cwt. According to analysis, the blast-furnace gases using the lesser weight of fuel had the following composition:—

	Volumetric.		By Weight.	
Carbonic acid	8·61	..	13·08 =	3·92 C.
Carbonic oxide	28·06	..	27·12 =	11·62
Marsh gas	4·37	..	2·41 =	0·96
Hydrogen	5·45	..	0·38	
Ammonia	0·13	..	0·08	16·50
Nitrogen	53·38	..	51·59	
Water	—	..	5·34	
Total	100·00	..	100·00	

Thus one volume of ammonia was accompanied by 796 volumes, or 12,500 parts by weight, of other gases. It is estimated that each ton of coal burnt in the furnace generates about 90,000 cubic feet of gas, and that it yields 4·38 lbs. of ammoniacal gas. Under such circumstances, it is quite obvious that the condensation of so small a quantity of this gaseous alkali becomes a very difficult problem when compared with operations where the same quantity has to be extracted from something like one-tenth of this enormous volume of gas.

Messrs. Baird and Co. were, I believe, the first to enter into this field of pneumatic research; and at an early period of their progress, I was permitted by this historical house in the Scotch iron trade to examine the apparatus they had erected at Gartsherrie for preventing the loss of the valuable alkaline gas, which up to then had been wasted. Now, almost every furnace in Scotland is provided with the necessary appliances for the recovery of ammonia and its conversion into sulphate. Among the latest of these adventurers are my other friends Messrs. Merry and Cuninghame, by whom, and by the constructors of their plant, I have been supplied with the fullest particulars of the process as it is followed at the Carnbrae Works.

We will now proceed to examine the nature of the establishment by which this remarkable result is obtained—effected as it is with almost the completeness of a laboratory experiment in apparatus designed and erected by Messrs. R. and J. Dempster. The plant used in the Dempster mode of obtaining products from the blast-furnace gases at Carnbrae consists primarily of dust-boxes, condensers, exhausters, washers, scrubbers, and separators, along with the tar and ammonia plants for working up the recovered tar and the so-called ammoniacal liquor. The gas is taken from the furnaces into the main gas-tube in ordinary use from close-topped furnaces; and it then enters the dust-boxes, where the dust, carried over in suspension or vaporized with the gases, is laid along with some 80 per cent. of the associated tar. The dust is deposited in the first or inlet partition, and is run out along with the intercepted tar into a small settling-tank, where the sediment is lodged; the tar then being allowed to run into the store-tank along with the large body of tar recovered in the other and subsequent sections of the dust-box. The gas on leaving the dust-boxes enters the condensers, which, like all the other parts of the gas plant, are in duplicate, and are arranged with valves, so that, in case of any part getting out of order, it can be shut off without interfering with the other parts of the apparatus. Each set of condensers consists of 144 wrought-iron tubes, 20 inches internal diameter, by 55 feet high; the whole being supported on cast-iron boxes, which are arranged with partitions for giving the gas the full travel of the condensers. The total length of piping thus in use is exactly 5 miles, having an external area of about 48,000 superficial feet. The condensed tar and ammoniacal liquor are taken off by trapped overflows, and conveyed from these into a separator and forward into the respective tar and liquor store-tanks. The temperature of the gas on entering the condensers averaged 130° Fahr.; and on leaving, 60° Fahr. This may appear very low to those who are accustomed to the use of furnaces fed with coke instead of raw coal; the greater reduction of temperature being, of course, due to the absorption of heat in gasifying the volatile portions of the raw coal. The tubes, it should be stated, are cooled externally by an arrangement of water-sprays fixed near their upper extremities.

After leaving the condensers, the gas passes through the exhausters, which are of the reciprocating type, and are so arranged that the gas cylinders and all the gas connections are placed outside the exhauster-house, in order to avoid risks in case of leaky connections. Thus all danger arising from the explosion of any accumulation of gas in the engine-house itself is avoided. Each exhauster is composed of two cylinders and four gas cylinders, and is capable of passing 550 cubic feet of gas per revolution. The design of the exhausters is such as to draw off the gas in a very steady manner—the pistons working at one-quarter centre. The engines are regulated by means of gas-governors worked by the pressure of gas in the main gas-tube. The gas is next forced into the washers, which consist of four cast-iron boxes, sealed with the ammoniacal liquor itself. The gas enters in the centre of each washer; and, after being washed by meeting the water-spray caused by the gas being broken up by perforated plates, it reaches the outlets, which are on each side of the washers. The washers are sealed with the liquor coming from the scrubbers, which constitutes the next element of the apparatus; and the overflow liquor or seal of the washers is regulated by patent slide-valves. The overflow liquor from the washers is carried to a separator, which works exactly opposite to the separator for dividing the tar and liquor from the condenser-boxes; the tar being of less specific gravity than the liquor. After leaving the separator, the tar and liquor flow to their respective store-tanks. The gas, after leaving the washers, then passes forward into the scrubbers, which consist of three towers, each 120 feet by 18 feet in diameter. These towers are filled with thin boards, about 7 inches wide, set on edge; each tier of boards being at right angles to those adjoining it. Gas enters No. 1 scrubber at the bottom; and, in travelling to the outlet at its top, it meets the liquor, which is pumped from the tank to the so-called distributor, which revolves in the inside of the top of the scrubber, causing the whole area of scrubber to be equally wetted, and thus presenting a very large scrubbing surface for the gas to travel over. The gas then leaves No. 1 scrubber and is conveyed to the bottom of No. 2 scrubber, where it undergoes a similar treatment as in No. 1. It then passes on to No. 3 scrubber, which is also filled with boards still more closely packed than Nos. 1 and 2; and in this tower fresh and clean water is used, for arresting the last traces of ammonia.

Suitable water-valves are attached to each scrubber, so as to enable the gas to be shut off from any scrubber, and to allow the others to be kept at work. The scrubbers are also provided with relief-valves; and, as in other parts of the plant, there are suitable manholes for cleaning, &c. The washed gas, thus deprived of its ammonia, is then conveyed to the hot-air stoves and boilers at the iron-works, and there used in the ordinary way. The yield of raw products has averaged 120 gallons of ammoniacal liquor of 2° Twaddell, and 25 gallons of tar, per ton of coal used in the furnaces.

The ammoniacal liquor is worked up into sulphate of ammonia by distilling with steam in continuous ammonia-stills; lime being introduced into the bottom compartment of the stills to remove any fixed ammonia, should this be present in sufficient quantity to pay for recovery. These stills are also heated by blast-furnace gas which has passed through the condensing apparatus. The ammoniacal gas from the stills is then passed into saturators containing sulphuric acid, where the sulphate of ammonia is deposited and then lifted out on to draining tables, and, when drained, transferred to the sulphate store-house. The waste gases from the saturators are used for heating the liquor previous to its entering the ammonia-stills.

The tar is treated in eight vertical tar-stills, each of which is capable of holding 7000 gallons. The stills are furnished with the usual accessories, condensing worms and tank, and oil-receiver. The oil is taken from the receivers into the store-boilers, and then blown by compressed air (a supply of which is necessary for working the tar-stills) to store tanks. The pitch left in the stills at the end of each distillation is run out into the pitch cooler on leaving the stills, and then forward into the bays for storing it. From the fact that a portion, probably a considerable portion, of the tar is distilled at a much lower temperature in the blast-furnace than when the operation is conducted in a gas-retort or in a coke-oven adapted for the purpose, we may be prepared to hear that the products differ in their properties. Accordingly, it has been found that the former is unsuitable for the production of aniline or other tar colours. It has been ascertained that, by passing the blast-furnace tar over red-hot coke, benzol and anthracene have been obtained. It is therefore not unlikely that future researches may confer a higher value on this substance than it now possesses.

By the courtesy of the Carnbrae Chemical Company, I am enabled to place before the meeting the results obtained at Merry and Cuninghame's iron-works over a period of three weeks. During this time, three of their furnaces were being blown during a fortnight, and four during the third week—equal therefore to three and one-third furnaces for the whole time. The weight of coal consumed was 5841 tons, which gave the following quantities of the three products:—

	Tons. Cwt.			
Sulphate of ammonia	48 8	sold at	£10 10s. =	£508 2 0
Pitch	361 0	,,	21s =	379 1 0
Oil	33,750 gallons	,,	1½d. =	210 18 9
				£1,098 1 9
Paid: Wages, sulphuric acid, management, railway dues, and allowance for depreciation of plant				379 12 3
Balance, profit				£718 9 6

And interest on plant = 2s. 5½d. per ton of coal.

If, as is proper, we regard the addition of sulphate of ammonia hitherto wasted, from a national point of view, we are entitled to credit the processes by which this is achieved with the difference between its present and former price. This, upon the quantity dealt with in the statement of account just rendered, means a gain of about £250.

The propriety has been suggested of using coal generally in the form of gas obtained by preliminary treatment in a Siemens producer. By this mode of treatment, the ammonia capable of being afforded by bituminous coal could be collected. To effect this, however, the gases would have to be cooled down in the manner described, which would involve a sacrifice of about 30 per cent. of the heating power of the fuel used. With cheap coal and a higher price for the ammonia salt, there does not appear any reason to doubt the practicability of such a system; but, as matters now stand, its advantages as a lucrative undertaking appear doubtful.

[The latter part of the paper dealt with the recovery of phosphorus, with which our readers are not particularly concerned.]

In the course of the discussion upon the paper (as reported in *Iron*),

The PRESIDENT (Sir Frederick Abel) said that he was sure the members were greatly indebted to Sir Lowthian Bell for his extremely interesting account of the bye-products attending the manufacture of iron and its conversion into steel. The paper, perhaps, did not afford much material for discussion; but it contained important information with regard to the apparatus now at work on a large scale for the recovery of ammonia, tar, and oil from the products of blast-furnaces. The apparatus exhibited evidently applied in a very complete manner the principles which had already been adopted in the purification of coal gas; the difference being that in coal gas the main object was to remove the least traces of impurity, with the view of having the gas as pure as possible, whereas in the present case the primary object was to remove the products as completely as possible with a view to their utilization.

Mr. SNELUS said it so happened that within the last twelve months he had been experimenting upon the use of sulphate of ammonia in regard to the growth of grass; and he thought that a simple statement of what he had noticed might be useful to some of the members, and would help to show the advantage of sulphate of ammonia, although, of course, agriculturists well knew the value of that manure. He had been experimenting with sulphate of ammonia in combination with nitrate of soda. He had applied about 1 cwt. of sulphate of ammonia and 3 cwt. of nitrate of soda per acre to grass on a lawn; and he had been remarkably struck with the enormously rapid growth of the grass under such circumstances. Within a week of the application of the mixture, the grass had begun to show a very vivid green; and within three weeks, the blades of grass had lengthened 4 inches —thus showing the valuable effect of those constituents upon the growth of plants. He now understood that it had become perfectly practical to apply the same manure to fruit-trees; and the cheapening of these forms of manure would be a very great advantage to the country generally.

Sir LOWTHIAN BELL asked how the grass grew which had no sulphate of ammonia applied to it.

Mr. SNELUS said that it made very little progress; it seemed simply to stand idle. In his first experiment, he sowed the sulphate of ammonia and the nitrate of soda over half the lawn. He was doubtful whether he might not kill the grass; but the marvellous effect was produced of one-half the lawn becoming a vivid green within a week, the other half being quite brown. He then applied the manure to the other half; and within another week the whole was as green as possible. He applied the mixture three times, at the rate of 4 cwt. per acre; and it was astonishing to see the rapid effect that was produced.

Sir LOWTHIAN BELL asked if the experiment indicated any advantage in a commercial sense.

Mr. SNELUS said that was another thing. In his case it had paid very well.

Mr. CUNINGHAME said that, in regard to the question of profit, the statement of Sir Lowthian Bell was perfectly correct at the time the paper was written. But, like other commercial commodities, the bye-products had their ups and downs; and at the present moment they were, like many other things in which they were interested, on the down-grade. On the question of profit and loss, the results would not be always as Sir Lowthian Bell had stated, but must depend upon the fluctuations of the market. He might add that it was generally believed in the North that the fertilizer of the future would be basic phosphate and sulphate of ammonia—the latter for its stimulating and the former for its sustaining qualities. So that they might expect in future that the bye-products of blast-furnaces would play an important part in the agriculture of the country.

The PRESIDENT proposed a hearty vote of thanks to Sir Lowthian Bell, which was carried by acclamation.

The Gas Industry before the Labour Commission.—Our readers will be interested to learn that the complete report of the fifth (and last) day's evidence given before the Labour Commission in connection with the gas industry has now been published by Messrs. Eyre and Spottiswoode. The price of the report of each day's proceedings is 2d.

REGISTER OF PATENTS.

Stirring and Drawing the Charge of Gas and other Retorts.—Foulis, W., of Glasgow. No. 12,385; July 4, 1892.

This invention consists in additions to, and modifications of, the apparatus described in patent No. 12,016 of 1890. (See JOURNAL for Aug. 4, 1891, p. 212.)

The present invention has for its object to so arrange and construct the machine that it is more rigid, and also (owing to the larger bearing-surfaces of its moving parts) more effective in its action. The arrangement also enables the working parts to be easily got at when required for oiling, repairing, and such like. The patentee proposes to mount on the top side of the I iron or steel bar forming the frame of the machine an iron or steel plate, which has also mounted at its underside two stiffening angle iron or steel bars, which may extend the whole length of the plate or not as desired. The main bar has the slipper or carriage mounted on its lower side, in such a manner as to enable it to be reciprocated backwards and forwards by the two horizontal-acting hydraulic cylinders and rams, as hitherto. But in this case, they are mounted on the top side of the plate, which is formed with two longitudinal slots or openings, through which the pulleys on the end of the rams work; the slots also acting as guides for the front ends of the rams, which are formed with suitably-shaped guide or slipper blocks. Also, the front end of the raising and lowering cylinder's ram is provided with a guide or slipper block, which works on the upright standard of the apparatus, which (as well as the plate) has wooden or other buffers attached, so as to terminate the strokes of the rams and slipper or carriage. Near the front end of the I or steel bar, there is mounted preferably a hardened-steel block, in such a manner as to guide the rake-rod—or it may be the stirrer rod or rods—during their backward and forward movements. The race of the automatic drop plate is so shaped that, when the apparatus is not in use, the plate will be nearly in a horizontal plane, and so permit of vehicles and such like passing underneath—the front end of the apparatus.

Charging Gas and other Retorts.—Arrol, W., and Foulis, W., of Glasgow. No. 14,440; Aug. 26, 1891.

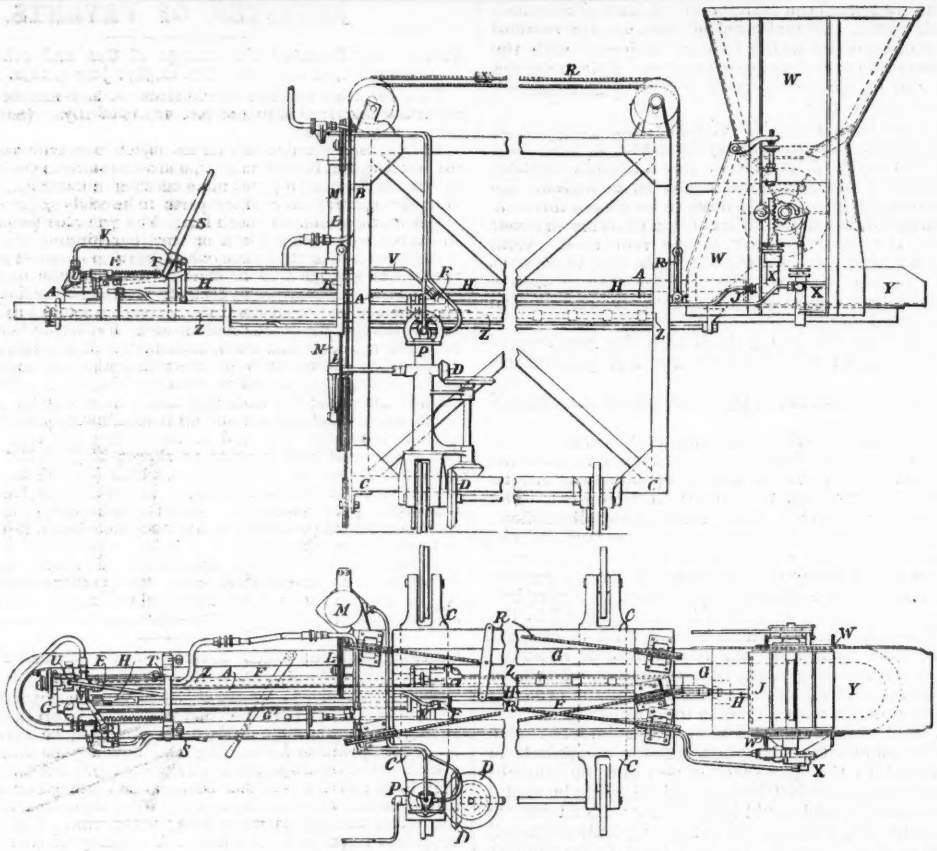
This invention has for its object to provide apparatus which will put a charge of coal or other material into a retort in an even layer. It may, in certain respects, say the patentees, be regarded as based upon the apparatus for stirring and drawing the charge of retorts described in Foulis's patent No. 12,016 of 1890; but it is so constructed that, in lieu of the rake-rod being raised when going into the retort and depressed when coming out, the rod is depressed when going into the retort and raised when being withdrawn. The action of the apparatus therefore is as follows: A quantity of coal or other material is allowed to fall from a hopper or chamber (which may or may not be fixed to the machine) on to a plate or shoot, one end of which is secured to the machine; the outer end being caused to rest upon the retort mouthpiece while the retort is being charged. The rake (or, as it may be called, the "pusher," as it acts rather as a pusher than a rake) is moved inwards; and, being then in its depressed position, slides along the plate or shoot, and afterwards along the bottom of the retort, pushing the coal before it. The pusher is then elevated, and moved outwards; it being elevated so that it may pass over any coal there may be in the retort at the rear of the pusher. Another portion of coal is then allowed to fall on to the plate or shoot and the operation is repeated until the retort is sufficiently charged.

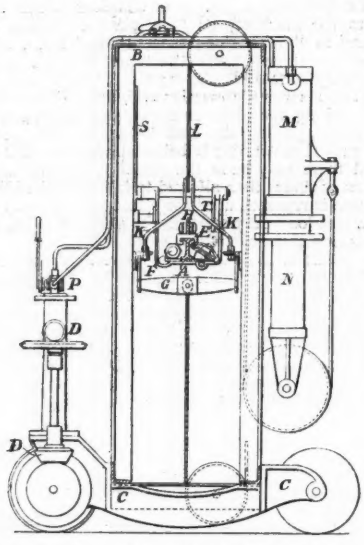
The illustrations (on next page) show a side elevation, a plan, and a transverse section of the machinery employed.

The main frame or slide-bar A is preferably constructed of an I iron or steel bar supported near its centre in an angle-iron or steel frame, suspended at both ends of the carriage C, so that it can be moved from one retort to another by any suitable means—such as by hand or power gearing D. Upon the slide-bar a slipper or carriage E is so mounted that it can be moved backwards and forwards by means of the rams of two hydraulic cylinders F, fixed to the slide-bar. The necessary travel may be given by chains or ropes, each of which is connected at its one end to the front end of one of the cylinders; thence passed around the pulleys mounted on the front ends of the cylinder rams—the other end being connected to the slipper or carriage. The rams are provided near the front ends with guide-blocks, which work in corresponding guide-plates G, secured to the slide-bar. To the slipper or carriage the back end of the pusher-rod H is jointed by a pin; the rod carrying at its forward end the pusher-plate J.

The frame of the machine is suspended by means of the carriers K and Q. The top end of the carrier K is secured to the one end of a raising and lowering wire-rope or chain L, which is passed around the guide-pulley mounted on the upright framing B, and around another guide-pulley mounted on the lower end of the ram N of the hydraulic raising and lowering cylinder M. It is secured by means of an adjusting screw to a snug or projection on the cylinder M, in such a manner that the frame, slide-bar, and their connections can be raised or lowered by actuating the valve P by the lever shown. The carrier Q is connected to the ends of two wire-ropes or chains R, which, after passing over guide-pulleys, are attached to a cross-piece or yoke connected at its centre to another rope or chain, which, after passing around a guide-pulley mounted on the upright framing B and around another pulley mounted on the ram N, is attached by an adjusting screw to the snug of the cylinder M. In this way, the frame, slide-bar, hopper, and connections are raised or lowered at the same time by the one cylinder M.

The frame is also provided with a balancing chain or rope, which, after being fastened at one end to the top end of the carrier, secured near the front end of the frame, passes round guide-pulleys, and is secured to the cross-piece or yoke, which is connected at its ends to the underside of the frame, preferably near its centre (as shown in the transverse section), so as always to keep the various parts in their relative positions to each other. The slide-bar A is connected to the frame near its centre, by means of a carrier, in such a manner as to permit of the slide-bar, with the pusher-rod H and pusher J, being raised and lowered at its ends by means of the operating-handle S, which is attached to a cross-shaft carried by the top ends of an inverted





saddle bracket secured near the rear end of the slide-bar. The cross-shaft has mounted on it a lever or arm T, whose lower end is connected to the regulating or reversing valve U by means of a rod or link; the valve being fixed to the cylinder and connected by means of a pipe V to the cylinder F actuating the pusher and supplied with water under pressure by means of a pipe having a branch, which also supplies water to the raising and lowering valve P connected to the cylinder M. The pipe is also provided with a flexible tube attached at either end to the metallic joints of the pipes, so as to allow for the raising and lowering of the frame and its connections. The shaft has also levers or arms mounted on it, the ends of which are connected to links, the lower ends of which are pivoted to the frame; so that, when the lever S is moved, the valve U is operated and the slide-bar is raised or lowered as required.

To the front end of the frame, the coal hopper W is fixed; having an adjustable hinged agitator, which can be adjusted by means of a lever, hand screw, and nuts. Underneath the agitator are mounted blades constituting a wheel or circular series of boxes on a cross-shaft, carried in bearings in the lower framework of the hopper. The shaft has a continuous rotary motion imparted to it from the reciprocating motion of the rams of the two hydraulic cylinders X, by means of a ratchet and pawl arrangement; the cylinders being mounted on the framework of the hopper, and supplied with water by means of a valve actuated by a lever, and kept in its normal position by a spring.

In order to receive a charge of coal from the wheel, there is mounted on the front end of the frame A, and underneath the blades, a plate Y, upon which the pusher J travels. The plate has a backward-and-forward movement given to it by a handle or hand lever and rod, so as to enable the plate to be introduced into the mouth of the retort when the retort is to be charged, and to be withdrawn therefrom after the retort has been charged. In order to automatically regulate the travel or length of stroke given to the pusher-rod H and pusher J, there is mounted underneath the slide-bar A a revolving shaft Z, having a number of stops or projections at different distances apart, and radially out of line with each other. Thus, on the shaft being partly turned, through the medium of a ratchet and pawl arrangement, brought into play through the raising and depressing of the rear end of the slide-bar, the various stops come into the path of the ram in succession; and so regulate or alter the stroke given to the pusher J, as the ram will be stopped in its charging stroke at a distance dependent upon which of the stops is in its path. The pawl is returned to its normal position on the reverse movement of the slide-bar. The stops work through openings formed in the guide-plate, and may be actuated by hand when desired by means of a hand-wheel provided on the rear end of the shaft.

The action of the machine is as follows: When it is required to charge a retort, the operator moves the machine by means of the gearing D, until it is opposite the retort to be charged. He then operates a lever, and so raises or lowers the frames until the plate Y is on a level with the mouth of the retort. He then operates another lever, which causes the plate Y to enter into the mouth of the retort and rest thereon. He then operates the lever S, which, by a single operation, causes a quantity of coal to be delivered from the revolving wheel of the blades on to the plate Y, the slide-bar to be depressed at its front end, and the rams to act so as to move the pusher J forward—carrying the charge before it into the retort, well towards the back. After the pusher has reached the end of this stroke (which is determined by the outermost of the series of stops), the operator reverses the lever S; and by so doing raises the pusher and withdraws it from the retort. After the pusher-rod reaches the end of its backward movement, the operator repeats the operations; and the shaft Z is partially revolved, so as to bring the next stop into position for terminating the next forward stroke of the pusher J, as already described—the stops being successively brought into position, so as to cause the pusher to travel a less distance into the retort at each successive stroke. In this way, the successive charges (which are deposited by the wheel before the pusher prior to each stroke) are pushed to a less and less distance into the retort, and so evenly spread therein. When the retort has been fully charged, the operator again actuates a lever, so as to withdraw the plate Y from the retort, when the machine is ready to be moved to another retort.

Automatically Regulating the Temperature of the Water used in Cooling Cylinders of Gas-Engines.—Shiels, A., of Glasgow No. 17,033; Oct. 7, 1891.

In carrying out his invention, the patentee proposes to fit into one of the water-tanks of the gas-engine, or into or around the water jacket of the cylinder, a worm, coil of piping, or a number of pipes or tubes (or the equivalent of either of these), to contain a fluid sensitive to, and expanding and contracting greatly under, changes of temperature. The piping communicates preferably with a syphonal arrangement, having mercury therein or its equivalent, and in which works a float or piston, whose rod is connected, directly or indirectly, to the plug or key of either the outflow or inflow cock from or to the tanks.

The piston-rod is preferably connected to the outflow cock, in which case the inflow cock is automatically opened and closed by a ball or float valve.

With this apparatus, should the temperature of the water in the tanks rise at any time above a certain fixed point—say, 140°— the expansion of the sensitive fluid in the piping forces up the mercury in the syphon, and consequently also the piston and piston-rod, which latter is so connected to the outflow-valve key or plug as to open it by its movement upwards, and thus run off the hot water, which (by the action of the inflow ball-valve) is replaced by a fresh supply of cold water. When the temperature falls again, through the influx of cold water, the outflow is gradually cut off by the falling of the piston in the syphon. In case the temperature rises very high, through some abnormal conditions, it is advisable to have a device to prevent such abnormal rise of temperature from doing injury to the automatic regulator. For this purpose, the piston-rod may be made with a spiral spring at its upper part, connected to the lever for turning the plug or key of the outflow valve. This spring serves as a cushion, and allows the piston to rise after the cock or valve has been fully opened; or to effect the same purpose, the lever on the cock or valve may be slotted, and so bent, that the pin on the piston-rod (which runs in the slot) can travel upwards without turning the lever, after the cock or valve is fully opened.

Gas-Engines.—Shaw, J., of Leeds, and Ashworth, J. R., of Chorlton-cum-Hardy, Lancs. No. 18,020; Oct. 21, 1891.

These improvements relate to gas-engines of the two-cycle type, of horizontal formation; and they have for their object the better utilization of the pressure within the cylinder, produced by the explosion of the mixture of air and gas, by forming at the end of the cylinder, and external thereto, a chamber for the admission of air and gas, and an exhaust chamber. In the former, the admission of gas is arranged at a point nearer the cylinder than the opening for the admission of air; and the latter chamber is connected with the exhaust-pipe, as is well understood. These two chambers communicate with the cylinder through ports arranged one above the other; and between the ports there projects, from the cylinder cover, a shelf or baffle-plate, which extends very nearly to the point where the piston arrives when it is at the extent of the inward portion of the stroke. The shelf or baffle-plate thus measures off the portion of the cylinder over and above the length of the stroke, which forms what may be termed the combustion chamber, and which is, by preference, of a cubical capacity of about one-fifth of the cubic measurement behind the piston when at the extent of the outward portion of its stroke. The object of the shelf or baffle-plate is to assist the products of combustion on their passage to the exhaust, and to separate them in some measure from incoming air and gas.

The complete cycle of operations is as follows: During the time the crank is moving from the inner dead centre for about 40° of its revolution, the air-valve is open; then, while the crank makes about another 80° of its revolution, the gas-valve is open in addition. At that point, the gas-valve shuts; and the exhaust begins to open. The air-valve is kept open until 180°, or the forward stroke of the piston, is completed; and the exhaust remains open until the crank arrives at 260° of the revolution, or 80° of the inward stroke. The exhaust then shuts dead; and the charge is compressed up to, and fired at or about, the dead point. The operations during the revolution following the explosion are of the ordinary character; and there is thus an exhaust at every revolution of the engine.

Test Gas-Meters.—Wright, F., of Millbank Street, Westminster, S.W. No. 18,195; Oct. 23, 1891.

This invention in connection with test meters consists in fitting to the index a bell or gong arranged to strike at any predetermined period of revolution of the index or counter, and thereby give warning that a certain volume of gas has passed through. For this purpose there is fitted on the shaft or spindle driving the index, an eccentric, cam, pin, or other suitable device in proper relation to the tail-end of a lever provided with a hammer head; the lever having a fulcrum or pivot attached to some rigid portion of the frame of the index or the case of the meter, together with a bell or gong arranged similar to the striking movement of an ordinary clock, but denoting volume instead of time. The index or counter of the meter being then set to zero or other convenient position, the gas or fluid passing through will impart motion to the index, and eventually cause the eccentric to lift the hammer and strike the bell or gong.

Valve Gearing for Gas-Engines.—Walch, J. S., of Prestwich, Dorrington, A. A., of West Gorton, and Coates, H., of Newton, Manchester. No. 18,276; Oct. 24, 1891.

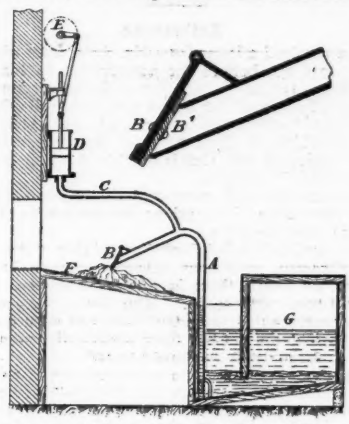
This invention consists in using for a gas-engine a circular cam or scroll actuated from the crank-shaft by bevel-wheels, and giving motion to a square or circular valve, placed at the side or ends of the cylinder. The valve is double ported; one for admitting the mixture, and the other for exhaust—the ports being so placed that only one is required in the cylinder. The motion of the valve is, briefly stated, as follows: At the end of the valve stem is fixed a small steel bowl or runner, fitting in the cam groove, which is cut so that, when the piston is at the back end of the stroke, the admission port is slightly open to the port in the cylinder and the admission port in the valve chamber, and continues to open until the piston arrives at about three-quarters of its stroke, when it closes quickly, and allows compression to take place. The valve is now stationary until exhaust takes place, when the exhaust port opens to the cylinder port and the exhaust outlet.

Gas Cooking-Stoves.—Sugg, W. T., of Vincent Street, Westminster. No. 12,876; July 13, 1892.

This invention consists in means whereby the appearance of the glazed tops of gas cooking-stoves shall be maintained, notwithstanding use, by forming the metal top "with raised parallel or diagonal ribs, or other raised portions, which will form the wearing surface." The top thus prepared will be glazed or enamelled in the usual way.

Sulphate of Ammonia Apparatus.—Maltster, W., of Catford, Kent. No. 13,208; July 19, 1892.

This invention relates to means for raising the sulphate of ammonia from the bottom of the saturator or pan, and placing it on a suitable drainer, so as to allow the fluid portion to fall back into the saturator



A is a bent pipe, in the form of a syphon, made of lead, and with one end dipping into the precipitated salts at the bottom of the saturator. B is a valve on the other end of the pipe, which consists of a metal plate hinged at the top, and set at an angle with the mouth of the pipe, and provided with an india-rubber face B^1, which rests against the bevelled end of the pipe. C is a pipe which connects the discharging arm of the pipe A, just beyond the bend, with the air-pump D. This pump has a solid plunger, to which a reciprocating motion is given in any convenient manner, such as a shaft and crank E, and connecting-rod, as shown. F is the sloping draining table on which the salt is deposited; and G is the saturator.

The mode of operation is as follows: At each upstroke of the air-pump D, a partial vacuum is created in the pipe A; and the pressure of the air causes the precipitated salts from the bottom of the saturator to ascend the pipe, and pass over the bend, into the other arm. At each down-stroke of the piston, the salts are forced out of this arm (the valve being free to open under the influence of the pressure), and fall on to the drainer, where the moisture drains off, and the salts are then ready to be placed in store.

APPLICATIONS FOR LETTERS PATENT.

15,925.—Hood, J. J., and Salamon, A. G., "Purification of coal gas." Sept. 5.

16,002.—Taylor, H. F., "Gas-fired furnaces for heating, re-heating, and annealing purposes." Sept. 6.

16,051.—Walker, J., Harwood, H., and Wilkinson, J. H., "New advertising gas or lamp globe." Sept. 7.

16,106.—Heirons, C., "Temperature indicator for ovens, boilers, furnaces, and other heated chambers." Sept. 8.

16,134.—Clinch-Jones, F. J., "Gas-furnaces." Sept. 9.

16,220.—Main, R. B., "Combined gas-fire burner and grate bottom." Sept. 10.

16,258.—Lewes, V. B., "Manufacture or production of illuminating gas from liquid hydrocarbons, and apparatus therefor." Sept. 10.

16,260.—Cannon, F. W., and Bauer, J. A., "Apparatus for reducing pressure in pipes." Sept. 10.

16,271.—Lewis, W., "Improved form of running socket and backnut for wrought-iron and other pipes which are joined by means of a thread or screw." Sept. 12.

16,273.—Bell, J. F., "Self-sealing gas-retort mouthpieces." Sept. 12.

16,339.—Griffin, S., "Liquid hydrocarbon and other motor engines." Sept. 13.

16,357.—Northcott, W. H., "Machinery for compressing air and other gases." Sept. 13.

16,382.—Brunler, O., "Cooling device for gas and petroleum motors, the cylinders and pistons of which are rotating round a stationary crank." Sept. 13.

16,413.—Redfern, G. F., "Gas engines or motors." A communication from the Société Anonyme des Moteurs Thermiques Gardi.

16,609.—M'Phail, J., "Supporting or strengthening pipes containing liquid under pressure." Sept. 17.

16,622.—Bowing, J., "Manufacture of coke, and the recovery of products." Sept. 17.

The Coal Contracts of the Huddersfield Corporation Gas Committee.—At last Wednesday's meeting of the Huddersfield County Council, the Gas Committee reported that the total quantity of coal purchased by them this year was 41,000 tons; that, by visiting the collieries, they had saved a sum of £487 10s.; and that the total saving effected on the purchases over last year's figures was £3500, or 1s. 8½d. per ton.

Deal and Walmer Gas Company.—The half-yearly report of the Directors of this Company states that the revenue account shows receipts amounting to £4902, and a total expenditure of £4016—leaving a balance of £885, which has been carried to the credit of the net revenue account. The balance of the net revenue account is £2056; but the Directors think it undesirable, under present circumstances, to recommend the same dividends as heretofore until it can be ascertained whether the present high price of coal will be temporary or permanent. They therefore recommend dividends of 4½ per cent. on the "A" shares, 2 per cent. on the "B" shares, and 3½ per cent. on the "C" shares.

CORRESPONDENCE.

[We are not responsible for opinions expressed by correspondents.]

Anthracene.

SIR,—I have received a letter from Mr. Smit, from which it is quite clear that he does not believe the explanation in his letter of the 1st inst., which he says has been "given to the conductors of gas-works on the Continent by two of the ablest and most reliable men engaged in the tar business"—that the low price of anthracene is due to the M'Kinley tariff, which is about as near the truth as that Tenterden steeple is the cause of the Goodwin Sands. The M'Kinley tariff "bogey," therefore, disappears.

I hear, however, that it is now said that there are substitutes for anthracene as the source of alizarine; but those who make this statement do not say what they are.

I read in last week's *Chemical Trade Journal* that "the world cannot do without alizarine, and that alizarine cannot be made without anthracene, of which there is a limited supply. Only madder root can substitute anthracene. The farm growers of madder have now, however, something better to do than return to the cultivation of a plant which did not pay them sufficiently, even when anthracene was sold at 8s. per unit on the old tests."

If, therefore, there is a substitute or substitutes, the discovery must be recent; and those who propagate this theory—being connected with the gas industry—would render a service by making the information public, and thus relieve the Chartered Company of the universally accepted suspicion that their action is the cause of the low price of tar.

Sept. 23, 1892. GEORGE LIVESEY.

P.S.—I see also in the paper above referred to (in the notice of Messrs. Sadler and Co.'s report) that there has been a "very serious shrinkage in the prices of the Company's products with the exception of bichromes, which have now been put on a satisfactory and profitable footing by an arrangement among English and foreign makers." If this can be done with one set of products, why not with others?—G. L.

SIR,—With regard to the depression in the dye-trade, which has been cited in justification of the low price ruling for anthracene and *pari passu* in defence of a policy that cannot be too severely condemned and denounced, it simply resolves itself into this—that there is all the more reason why producers should act in perfect unison, and make a determined stand now; for it is but natural, and in the eternal fitness of things, that one should hold an article when there is little or no inquiry for it, and wait till trade revives, and the demand becomes brisk again.

In this case, one fact stands out clear and prominent—so clear and prominent indeed that one almost shrinks from pointing it out. It is this: That anthracene is as right now as it has ever been, and that it cannot possibly go wrong as long as sufficient time be given it to develop, and attain its full and proper value, before it is placed upon the market. What ruined the trade for years past was its being sold for merely what it would fetch before there was ever any real or immediate demand for it.

Nothing can alter this simple fact, which is as true to-day as it was ten years ago.

Sept. 23, 1892. VERITAS.

SIR,—With many holders of gas stock, I have read with great interest your editorials, and the correspondence you have published, on the effects of the price of anthracene on the gas industry. I would suggest that the present is a most opportune time for further discussion and for action. A great reduction in the price of gas residuals, necessitating an advance in the price of gas, will cause great joy to the founders of electrical installations. Every gas proprietor must therefore be deeply concerned with this question; and is greatly indebted to you, as well as to Mr. Livesey for his opportune letters.

It is quite unnecessary to occupy your space in discussing the stated causes of the low price now ruling for anthracene. The eight or ten makers of alizarine who alone are users of this hydrocarbon, have agreed to depress the market, and, meeting no concerted action, are easily successful. The value of the statement that these alizarine manufacturers cannot afford to pay a higher price, may be estimated by a statement of the annual dividends of three of the largest companies for the years 1889, 1890, and 1891. One, with a capital of £825,000, paid in dividends 20, 22, and 22 per cent.; another, with a capital of £600,000, paid 20, 25, and 26 per cent.; while a third, with a capital of £450,000, paid 15, 16, and 17 per cent. Their friends occasionally reply that these profits are made from aniline sales; but, when questioned respecting the ruinous prices of benzols, they refer you to their extensive alizarine business as the source. Our trade statistics, as well as those of the East, of the United States, &c., show that the consumption of alizarine is steadily increasing.

It seems, then, that a most favourable opportunity now offers for combined action on the part of gas producers and tar distillers, in order to secure fair terms from the colour makers. A combined Union might with ease arrange for the disposal of the anthracene produced in Great Britain during the next five years, so that sales might be justly and fairly regulated.

It has been urged, since this discussion arose in your columns, that the tar distiller may not be so deeply interested in the price of anthracene as the gas-works proprietor; since high-priced anthracene means high tar value. I should think he is equally concerned; for abrupt and large movements in the levels of value are most injurious to the distilling business. The losses to the tar distiller from this cause during the last nine months must have been more than serious. But if all the gas directorates were interested, it would be impossible for a distiller to act disloyally. Anthracene can only be obtained from gas-tar; and hence without a supply of this residual, he could not play the Union falsely.

It seems to me that Mr. Livesey could not add more effectively to his past services to the gas industry than by framing a scheme to deal with this product. Surely the "Court" at Horseferry Road will not stand in the path.

Sept. 22, 1892. GAS STOCK.

Mr. Gadd's Mechanics.

SIR,—In reply to Mr. George Livesey's letter, I wish to say at once that, if I did misunderstand his first letter with regard to the forces operative to seal the cups, I shall regret having been at what he may think unnecessary trouble in demonstrating the same; but I will point out that my conclusions lead to the inadvisability of allowing two out of only three lifts going free of guide-framing, unless they are provided with other support than the pressure of the gas at the cups. Of course, it is different with two out of (say) five lifts.

I could not deal with *both* the subjects Mr. Livesey referred to in one communication; and, therefore, I very naturally, and I think properly, took one at once. As to my not having yet proceeded to the second, and perhaps more important subject, I must appeal to Mr. Livesey's acknowledged high sense of fair play. He must please appreciate that I have been met at the outset in a most objectionable manner; and until my premises are either acknowledged or refuted, it would be utter waste of time to proceed, because the whole demonstration rests upon the adoption of ordinary mechanical principles, which I never before heard called into question. Those principles are either right or wrong. If any man can *prove* them to be wrong, he has a right and duty to do so. I only ask that it be attempted in a proper manner, free from personalities. My opponents rely solely on their own *ipse dixit*, and assertions of infallibility or great superiority. Instead of argument, Mr. Milbourne can only keep repeating that I do not understand what I am talking about. It is, therefore, his duty to show that he *does;* and I shall consider it cowardly in the extreme if he runs away from the ordeal.

Before any further progress in dealing with the other part of the subject can be made by me, the formula put forward by Mr. Cripps for finding the centre of pressure must be either proved or withdrawn. I say unhesitatingly that it is—for the purpose as applied—a great mistake. I believe that I clearly see *how* the mistake was fallen into; because $\frac{v_1 p + v_2 q + v_3 r}{p + q + r}$ might be a correct formula, provided only that the values of the forces p, q, and r are *already known*. If p, q, and r be *assumed beforehand* to be equal respectively to v_1, v_2, v_3, then the expression would be equal to the formula given; but that is surely assuming—as I have already indicated—the very thing we require to prove. This, the formula complained of actually does assume. It furthermore contains within itself a *reductio ad absurdum*. Now a clever man may occasionally make a mistake, and it may be ordinarily looked over; but when a mistake is made under the guise of superior knowledge, and correction of assumed errors which do not exist, and then persisted in, and accompanied with gross personalities, a serious wrong has been done to a known professional man, calculated to possibly injure him very materially.

It will be noted that, although I was first charged with not understanding the *elements* of mechanics, Mr. Milbourne now apparently reduces this to a supposed one-sided knowledge of the moment of inertia. I therefore call upon him to show wherein consists the difference of *result* between what he terms "geometrical" and "mechanical" moments of inertia; and how this can be made to prove the truth of the formula.

It is clear he is finding my knowledge rather inconvenient to him, as he is astonished at what he terms my "subtlety and ingenuity in argument." If his knowledge is of the superior quality he assumes, he ought to be able to blow such subtlety, &c., to the four winds of heaven with the first breath of real truth. My quotations are *precisely* applicable; and any quantity of mere *assertion* will not make them otherwise. My opponent attempts no kind of *proof*, and has not given one single reply to my questions, or dealt with any of my questions in detail. Can your readers understand this to be, in any sense, fair fighting?

Manchester, Sept. 21, 1892. W. GADD.

The Employment of Chemists in Gas-Works.

SIR,—Your correspondent "Chemicus," in his letter on the employment of chemists in gas-works, touches the fringe of a subject on which much may very profitably be said. That a chemist competent to carry on research work in a gas-works would be of great advantage to the works, is nowadays pretty generally admitted. That the engineer is the stumbling-block in the way of such an appointment, however, is open to question. The engineer has nothing to fear from the chemist; and he must be a man of small ideas indeed who, through jealousy, would object to so desirable an addition to his staff.

Presuming "Chemicus" throughout to refer to a *works* chemist, I consider he touches a wrong chord altogether when he speaks of the chemist acting as a "check" on the engineer. If this has to be their respective positions, friction is almost inevitable. The chemist is, or ought to be, in all cases under the direction of the engineer; and his true function would rather be in all cases that of an *adviser* to the engineer on questions relating to the chemical administration of the concern. The adoption of the specialist's advice and suggestions could only redound to the credit of the engineer in any case. If there are engineers so blind to their own interests as not to admit this, the sooner they are pensioned off, the better it will be for the works they have charge of.

The true reason of our slow progress in this matter is rather due to the attitude of the men who constitute the boards of directors and gas committees throughout the country. They, as a rule, think they pay a salary sufficient to provide for all the necessary knowledge and qualifications in the engineer himself; and, to the honour of the profession be it said, there are gas engineers at the present day who, among all their other multifarious duties, have found time to qualify themselves and become excellent chemists. It is certain, however, that the position of chemist can never be filled adequately, until the fact is fully recognized that, to be a successful and reliable research

chemist, a man must have gone through a long period of training and study, and that such a man must be paid at a rate commensurate with such a training, and not at the rate of a "retort-house ganger," as seems to be the rule with certain companies and corporate bodies in the present year of grace.

The tendency of the times is surely moving in this direction; and the day may not be so far distant, when the trained chemist will be as necessary a quantity in our larger gas-works as the engineer himself.

"TALKIN TARN," F.C.S.

Sept. 24, 1892.

Railway Carriage Lighting.

SIR,—My attention has been directed, in the current issue of the JOURNAL, to the discussion which took place at the meeting of the South-West of England District Association of Gas Managers, on the question of "Railway Carriage Lighting," in which my name was mentioned in connection with the experiments made some years back, on the loss in compression of coal gas, and the tabulated results I then laid before the Southern District Association of Gas Engineers and Managers. I should like to state that I have no doubt of the substantial accuracy of those experiments; and they were afterwards amply confirmed in practical working, and formed the subject of a communication to the JOURNAL in September, 1885 (Vol. XLVI., p. 507). This experience was continued afterwards for some time.

With regard to the general question of railway carriage lighting, it should be borne in mind that my investigations were initiated in order to demonstrate whether it was possible to avoid the necessity of erecting special oil-gas works; and there is no doubt that, where this is not considered advisable—such as for short branch lines, &c.—ordinary compressed coal gas can be satisfactorily applied. But for long-journey trains, and generally, oil gas presents the greatest advantages from nearly every point of view; and it is gratifying to note that it bids fair to be universally adopted on all the great lines. The principal thing wanted to make it quite satisfactory is that a proper amount of gas should be used, and that the lighting of the coaches should be solely in the charge of one department of the railway.

CHAS. E. BOTLEY.

Hastings, Sept. 22, 1892.

The Inclined Retorts at the Huddersfield Gas-Works.

SIR,—I notice in the issue of the JOURNAL for Aug. 30, p. 398, respecting "Gas and Electric Lighting Affairs at Huddersfield," that an error has crept in respecting the amount to be paid by this Corporation to the Automatic Coal Gas Retort Company, Limited, for the use of their patented appliances in connection with inclined retorts. The sum stated—viz., £600—is not now correct; but is the original offer when settings of fewer retorts were contemplated. But as I have now determined to have settings of nine's, the Corporation will necessarily have to pay for the increased linear dimensions.

W. R. HERRING.

Huddersfield, Sept. 23, 1892.

The Keswick Water-Power Electric Light Station.

SIR,—I think most of your readers will remember how, a little more than two years ago, they, and the rest of the civilized world, were told of the wonderful realization of a town lighted by its own water power. First the "Dailies," then the "Engineering Journals," and finally the "Monthlies" took up the wondrous tale. The climax was reached in a paper read in London, before the Institution of Civil Engineers; the excuse being that "it was believed to be the first attempt to utilize available water power in this country for the purposes of a public supply of electric light."

The rent to be paid for the water was only 10s. per horse power per annum; and taking the number of horse-power-hours required per annum from a 50-horse power turbine, the cost came out as 16-horse power for 1d. And what was to be done with the extinct volcano up at the gas-works? That seemed to be the only serious aspect resulting.

It was at the same time pointed out that, if coals had been used, taking 6 lbs. per horse power, the cost would have been, at 15s. per ton, no less than 0·48d. per horse power, or eight times that of water power. No wonder "the authors decided to recommend the Directors to obtain a site on the River Greta;" the head and tail races of an old mill therefore being a still further providential provision—Art having come with a helping hand to assist Nature. But—lest all this should admit of "a possibility of partial failure during extreme drought in summer—it was decided to provide steam in addition. The stand-by engine (a 50-horse power Westinghouse) is fed by a 20 nominal horse power Hyde duplex vertical boiler."

Then, after a minute description of every electrical feature, we further learnt how, "in connection with the arrangement, the authors had occasion to make a comparison between the illuminating power of the glow lamp and gas." Naturally it was found "that the relative values usually given are misleading;" and that the true value was "one 16-candle power glow lamp gives approximately the same degree of light as two ordinary burners, each consuming 5 cubic feet of gas per hour." And—to put the matter utterly beyond the reach of any further dispute whatever—we were assured, "this conclusion seems to be borne out by the result obtained by Dr. Hopkinson." After that, of course, any further question would be almost blasphemous.

In the discussion, Mr. W. W. Beaumont raised a rather discordant note, for which he should at once have been "sat upon" by the President. He actually pointed out that the brake horse power of the engine was 50, and the boiler to drive it 20 nominal horse power; and he was puzzled to know how such a boiler could drive the engine. In reply, the authors said, "the 20 nominal horse power boiler had been found quite equal to the supply of steam for a 50-horse power engine with a good draught."

Well, taking a few days holiday in the district lately, and seeing some of the principal shops lighted by this providential illuminant, I naturally made inquiries into the results of two-and-a-half years' working. The resources of Nature and Art had apparently both proved insufficient. The turbine had needed the assistance of the boiler; and that had also failed, and was in consequence resting on its side; while a more suitable one had been, I was informed, installed in its place. Also I learned that the concern, having exhausted its supply of cheap power, required a little more capital—as such concerns, of course, will sometimes do.

Now in March, 1891, the *Electrician* gave us a short account of the annual general meeting of the Company. The Chairman pointed out this lack of money; but he said the reply "had only been partial." He further said the water supply had been precarious during the winter; the engine had not been of the help they expected; but their engineer had assured them it would be in the future. What a happy thing it is for electricians that there is "a future!" Since that time a year has elapsed; and I learnt that the last meeting "was not open to the reporters."

I suggested to a gentleman who seemed hopeful, that the resources of Nature at Keswick, were still far from being exhausted; they might have an abundant supply of horse power at much less than 10s. a year, if they would only erect a series of windmills on the top of Skiddaw. I expect this is now under consideration, and will report progress.

NIL DESPERANDUM.

Sept. 22, 1892.

P.S.—I think I should mention that meetings of gas shareholders continue to be held, and that they have even an increased profit and a dividend of 8½ per cent.

Projected Extension of the Goole Gas and Water Works.—The Directors of the Goole Gas and Water Company are proposing to make a call upon the shareholders for further capital to the extent of £20,000, with which to enable them to place the water supply of the town upon a satisfactory basis, and also to effect necessary improvements at the gas-works. The scheme has not yet been fully matured; but, if a call of £20,000 is made, the Local Board, as third-part shareholders, will be called upon to subscribe £6000 or £7000.

Gas Coke Contracts in the Midlands.—In view of the expected high price of fuel this winter, great interest attaches (says a Newcastle contemporary) to the annual contracts for gas coke now being let in Staffordshire and the Midlands. Circulars are being issued by the gas companies to ironmasters asking for offers over the next twelve months. Tenders received last week from some of the leading buyers quoted £9 15s. to £10 per boatload, or a drop of 1s. a ton on last year Sellers, however, declared the price should be £10 5s. to £10 10s.

The Lighting of the Streets and Courts of Birmingham.—The report of Mr. W. S. Till, the City Surveyor of Birmingham, for the year ending March 31 last states that the total number of lamps under the control of the Public Works Committee at that date was 9272, of which 892 were in the districts of Balsall Heath, Harborne, and Saltley. Concerning the question of the lighting of courts, Mr. Till mentions that in his previous report, it was stated that the plans, &c., had been prepared and the notices served in respect of the lighting of 440 courts. The lamps have since been erected; and subsequently notices were served in respect of 511 additional courts, and, where they have expired, the works are in progress. There have been several appeals against the works specified; but in all cases the Stipendiary has decided in favour of the Corporation.

Damages against Water-Works Contractors.—At the Preston County Police Court last Saturday week, Messrs. John Watt and John Wilson, of Glasgow, contractors for the Elston portion of the Thirlmere water scheme of the Manchester Corporation, were summoned, under the Highway and Locomotives Act, by the authorities of Elston, for alleged damage to the roads in that township by extraordinary traffic during the week, for which they claimed £86. Mr. Dagger, the Highway Surveyor, said the road was almost impassable at times in consequence of the heavy waggon traffic. Mr. B. Sykes, as agent for the township, declared that the payment of the claim if ordered would not satisfy him. The defendants had done twice that amount of damage; and he was afraid he should have to compel the Surveyor to bring the defendants there again. The defence was that the road was never fit for heavy traffic during the winter; but it was admitted that there had been extraordinary traffic. The Bench ordered the payment of £80 and costs.

Shrewsbury Gaslight Company.—The annual meeting of this Company was held last Wednesday. The report of the Directors stated that the continued high price of coal had borne heavily upon the Company during the year; and there had been a considerable reduction in the receipts for residuals. The Directors, however, hoped to avoid the unpleasantness of having to raise the price of gas, as they had been able to secure more favourable contracts for coal for the current year. The consumption of gas during the past year had increased to a small extent. The revenue account showed receipts amounting to £24,322; and the expenditure, £19,931—the balance being £4391. The available balance of profit amounted to £5028; and the Directors recommended that the authorized dividend of 7½ per cent. be declared. The Chairman (Mr. A. G. Brookes), in moving the adoption of the report, referred to the troublous times through which gas companies had of late been passing; and, in suitable words, he recognized the indebtedness of the shareholders to their Engineer and Manager (Mr. W. Belton, Assoc.M.Inst.C.E.), for the able manner in which he had overcome the difficulties which had beset them. The Company had shown marked progress of late years; the increase in the business having been 65 per cent. in thirteen years. The reserve fund amounted to nearly £8000; and this, he thought, must be a source of gratification both to the shareholders and Directors. In seconding the motion, Mr. Spencer Phillips quoted a few figures showing the difference between the position of the Company now and in 1879, when Mr. Belton became associated with them. The capital had advanced from £56,000 to £83,500; the make of gas had increased 65 per cent.; the sales of gas, which then amounted to £12,800 (the prices varying from 3s. 3d. to 3s. 9d. per 1000 cubic feet), had increased to £17,678 (the prices being 3s. to 3s. 3d. per 1000 feet); while the wages had risen from about £1000 to £1692. They had also paid off something like £7000 out of the suspense account; thus saving any increase of capital which might have been necessary to carry on the works. The report was carried.

MISCELLANEOUS NEWS.

SULPHATE OF AMMONIA IN POTATO GROWING.

In the spring of the present year, the *Standard* newspaper—in their periodical article on "Home and Foreign Agriculture"—made mention of a method of treating seed-tubers practised by a French grower, to the following effect:—

"Experienced potato growers will be apt to smile sceptically when they are informed that they can easily grow 42 tons per acre. Mr. Warburton, however, writing from La Rochelle, assures them that a French grower finds no difficulty in achieving so wonderful a result. This very successful producer selects the best and soundest of seed-tubers of medium size, and plants them whole; while he cultivates deeply and manures liberally. So far there is nothing at all out of the common; but the grower also immerses his seed-tubers for 24 hours in a solution of 6 lbs. of sulphate of ammonia and 6 lbs. of nitrate of potash in 25 gallons of water, allowing the tubers to remain for another 24 hours afterwards, so that the germs may have time to swell. It is to the increased activity of germination produced by this stimulating bath, that he attributes his enormous return. Perhaps some growers in this country will try the plan, and make known the results. If they get half the crop said to have been produced by the French grower, they will be well satisfied."

From last Friday's number of our daily contemporary, we learn that the suggested experiment has been carried out. The Rev. J. J. Milne, of Alleyn Park, West Dulwich, writing under date of the 22nd inst., says that, being sceptical as to the results said to have been obtained from the French grower's treatment, he determined to try it on a very poor piece of ground—viz., an old raspberry bed, which, of course, was trodden hard—and used as seed the small potatoes which remained after planting the other ground, the sets being very small, and weighing from half an ounce to an ounce each. The piece of ground was 21 yards long by 5½ yards wide; and the potatoes were planted in ten rows, allowing about 20 inches between the rows, and from 10 to 12 inches between the sets. He planted the seed with manure in shallow trenches, which were very difficult to make owing to the hardness of the ground; and before planting, in accordance with the instructions given, he immersed the tubers for twenty-four hours in a solution of 1 lb. of sulphate of ammonia and 1 lb. of nitrate of potash in 5 gallons of water—allowing the tubers to remain for another twenty-four hours exposed to the air, so that the germs might have time to swell. They were planted on the 6th of April, and were taken up on the 13th of September, and gave a return of 15½ bushels. The soil was heavy clay, which had not been worked for three years; but very few of the potatoes were diseased, and the tubers were decidedly above the average in size. Side by side with the above, he planted a well-worked piece of ground, 21 yards long and 15½ yards wide, with good sound tubers of medium size, which gave a return of 30 bushels, very few being diseased. It will be seen at once, says the reverend gentleman, that the seed tubers which were soaked in the solution gave a return at the rate of 651 bushels to the acre, while the others, though much larger tubers, and on superior soil, yielded only at the rate of 446 bushels to the acre. So that the yield from the former was nearly 50 per cent. more than that from the latter; and he has no doubt that, if the soil in the two cases had been of the same quality and the tubers of the same size, the crop from the former would have been still more abundant. The chemicals cost 1s. 3d. He recommends potato growers to try the experiment next year with (say) a quarter of their seed, and carefully compare the result with the rest of the crop.

EDINBURGH AND LEITH GAS COMMISSION.

The Accounts for the Past Year.

In his "Notes from Scotland" last week, our Edinburgh correspondent referred to the analysis of the past year's accounts of the Gas Commission, prepared by Mr. J. S. Gibb, the Treasurer of the department. Many of the figures contained in the return were alluded to by our correspondent; but it may be useful to give, in tabular form, the principal items from the accounts. They are as follows:—

	Total Amount.	Per ton of Coal carbonized.	Per 1000 c. ft. of Gas Made.	Per 1000 c. ft. of Gas Sold.	Proportion due to Leakage, &c.
	£ s. d.	s. d.	s. d.	s. d.	d.
Manufacture	175,429 14 1	25 11·37	6·84	10·47	3·63
Distribution	20,326 10 9	3 0·09	0·57	0·00	0·43
Management	6,420 14 6	0 11·39	1·13	1·26	0·13
Feu duties, rates, and taxes	8,231 1 0	1 2·60	1·45	1·61	0·16
Law and parliamentary charges	336 1 3	0 0·60	0·06	0·06	—
Pensions and allowances	1,474 3 1	0 2·61	0·26	0·29	0·03
Discounts and bad debts	6,205 5 2	0 11·01	1·09	1·22	0·13
Gross cost of gas	218,423 9 10	32 3·67	2·40	6·91	4·51
Less Residuals—					
Coke	5,996 16 2	0 10·64	1·05	1·18	0·13
Waste lime	53 14 0	0 0·10	0·01	0·01	—
Tar	15,603 1 10	2 3·69	2·75	3·06	0·31
Misc. receipts	340 16 2	0 0·60	0·05	0·07	0·02
Total	21,991 8 2	3 3·03	3·86	4·32	0·46
Net cost of gas	196,429 1 8	29 0·64	10·54	2·59	4·05
Balance, being gross profit	74,488 18 0	11 0·21	1·09	2·63	1·54
By revenue from gas	270,917 19 8	40 0·85	3 11·63	5·22	5·59

OTTOMAN GAS COMPANY, LIMITED.

The Ordinary Meeting of the shareholders of this Company was held last Tuesday, at the London Offices, 9, Queen Street Place, E.C.—Mr. E. HORNER in the chair.

Mr. T. GUYATT (in the absence of the Secretary, Mr. A. J. King) read the notice convening the meeting; and the report and accounts for the past half year (a few figures from which were given in the JOURNAL last week) were taken as read.

The CHAIRMAN said that, before proposing the adoption of the report, he would make a brief comparison of the accounts with those for the half year ending June, 1891. In the past six months they had consumed 133 tons more coal; and the gas-rental had increased from £7835 to £8359—the increased sum having been mainly produced by a much better yield of gas. In addition to this, although the quantity of coal carbonized was 133 tons more, it had cost £302 less. There was one important item of which there was no similar charge in the accounts for the corresponding period of last year—viz., £372 7s. 2d., which arose from the writing off a depreciation of 1 per cent. per annum from the cost of the works. He believed the shareholders would consider that the report and balance-sheet were, on the whole, satisfactory; and he concluded by moving their adoption.

Mr. A. J. DOVE seconded the motion, which was unanimously carried.

On the proposition of the CHAIRMAN, seconded by Mr. DOVE, a dividend was declared at the rate of 7 per cent. per annum on both classes of shares.

A vote of thanks was then passed to the Consulting Engineer (Mr. H. W. Andrews), the Engineer and Manager (Mr. John Gandon), and the Secretary.

Mr. ANDREWS having replied, Mr. JOHN GANDON said it gave him much pleasure to be present at the meeting, to acknowledge the compliment. He could assure the shareholders that the staff did all they could to obtain good results; and he thought the balance-sheet showed that their efforts had been successful.

A vote of thanks was also accorded to the Chairman and Directors; and the proceedings terminated.

SAN PAULO GAS COMPANY, LIMITED.

An Extraordinary General Meeting of this Company was held last Wednesday, at Winchester House, Old Broad Street, E.C.—Mr FREDERICK DELMAR, F.S.A., in the chair—for the purpose of authorizing the Directors to raise 7 per cent. debentures to the extent of £50,000 on the undertaking of the Company.

The MANAGING DIRECTOR and SECRETARY (Mr. J. Heath) having read the notice convening the meeting,

The CHAIRMAN proceeded to explain why it had been necessary to call the shareholders together, and ask them for power to raise the sum mentioned. He said the chief reasons for the absence of profit on the undertaking had been the low rate of exchange; the expenses of discharge at Santos, which had raised the cost of coal to two and a half times what it was last year; and the increase in the rate of wages, which in most cases had amounted to 100 per cent. Up to December, 1891, the gas was supplied to private consumers at the rate of 340 reis per cubic metre; but owing to the low rate of exchange, it was impossible to work at a profit at this price. The charge was therefore raised to 360 reis per cubic metre on January 1 last; and this had resulted in a fair trading profit in the half year to June last—the net result, however, only showing between £3000 and £4000 profit. On July 1 last, the price was again raised to 480 reis per cubic metre; and at this rate, and with the improvement daily taking place in the rate of exchange, there was every prospect of more satisfactory results. The question of demurrage had also been met by an extra payment having been made to the owners of vessels, who took the risk; and when practicable the cargoes were now shifted into hulks which had been supplied for the purpose. Referring to the increased cost of coal, he said for the six months to December, 1890, their coal cost them £13,212; for the half year to June, 1891, £13,787; for the half year to December, 1891, £27,382; and for the half year to June, 1892, £35,402. These prices were all for about the same quantities of coal. One of the Directors (Mr. D. M. Fox) had gone to San Paulo; and on his return, he would furnish them wtih a report as the result of his personal inspection. He mentioned that the rate of exchange, which at one time had been as low as 9½d., stood that day at 13¾d.—which seemed to show that the state of things in Brazil was decidedly improving.

Mr. R. JONES said they were asked that day to give a first mortgage charge on the undertaking; and he thought that was a very serious thing. They had had a very interesting statement from the Chairman; but he would be pleased to hear for what purpose the money now asked for was required. The shareholders had been called together just before the time when they would receive the half-yearly accounts; and he thought it would be more satisfactory to adjourn the meeting until these accounts were in their hands. The Company had been able to work all these years with liquid assets amounting to £8000; and he wished to know why the Directors that day found it necessary to ask them for £50,000 for the purpose of carrying on the undertaking. He moved an amendment that the meeting should be adjourned till after the accounts of the Company for the past half year were in the shareholders' hands.

Mr. EDWARD EVANS seconded the amendment.

Mr. ROBINS, in supporting the amendment, asked if the £50,000 was required for the purpose of enlarging the works; as, if so, he thought, considering the present small profits on the concern, it would be better rather to curtail than to increase the business.

Dr. E. BATT said that the £50,000 was not required for enlarging the works; but as all the money in hand had been exhausted, owing to the charges which they had incurred on demurrage, &c., the Directors needed more cash to carry on the business of the Company.

After some further discussion, the amendment was carried *nem. con.* and the meeting was therefore adjourned for a fortnight.

THE AGITATION AGAINST THE SALFORD CORPORATION GAS DEPARTMENT.

A Lancashire correspondent, referring to the revival of the agitation respecting the gas supply in the Salford out-districts (a subject to which reference was made in our editorial and news columns last week) writes as follows:—

For the second time, the Eccles Local Board have failed in the endeavour to persuade the ratepayers of their district that it would pay to undertake the manufacture of gas. Last Wednesday week, a public meeting refused to pass, by an overwhelming majority, a resolution which would have empowered the Local Board—or the Corporation which will be elected next November—to promote a Bill in the coming session of Parliament, enabling them to purchase the mains of the Salford Corporation and erect works for the manufacture of gas. A similar proposal by the Swinton and Pendlebury Local Board—another local authority in the Salford out-district—was rejected by Parliament last session; and now that the Eccles people have so emphatically recorded their opinion, the last has probably been heard of an agitation which has been prosecuted with much vigour against the Salford Gas Department during the past two years. The chief and indeed only valid objection to the existing arrangement, by which the Eccles and Swinton districts are supplied with gas by Salford, is that the differential rate has borne somewhat heavily on the consumers in these places. It is said—and rightly—that a very high price ought not to be charged for gas merely to enable municipal authorities to carry out extravagant schemes, which the ratepayers would oppose if they were directly taxed for them. That objection the Salford Gas Committee have, however, almost swept away by reducing the differential charge to a nominal 2d. per 1000 cubic feet. The price of gas in the Eccles and Swinton districts is now only 2s. 6d.; and the authors of the scheme for erecting separate gas-works do not seem to hold out hopes that they could improve upon this, though they talked vaguely of large profits made out of gas undertakings, and of the financial benefit which the ratepayers were to reap. One of the arguments adduced at the ratepayers' meeting was that, if the Bill were lodged, Salford might be coerced into offering better terms. But it fell on deaf ears. The opponents of the scheme bluntly said that enough money had been wasted in contests with the Corporation, and declined to trust the Local Board with power to deposit a Bill lest the temptation to go on with it should prove too strong. All things considered, the ratepayers of Eccles are to be congratulated on their decision. The district is largely residential; and the owners of the villas and mansions in the neighbourhood have not been overjoyed at the prospect that gas might be made at their very doors, instead of a few miles away. Salford cannot be said to have abused its privileges of late years; and the recent reduction in the differential price removes almost every shred of grievance which the outside consumers have. Under the circumstances, there is grave reason to doubt whether parliamentary sanction would have been given to the Board's scheme. If Swinton and Eccles could last year have agreed upon a joint scheme, they might or might not have succeeded in carrying it; but we see no reason to believe that the Eccles Local Board would have succeeded where the Swinton and Pendlebury Local Board failed. There is some prospect of the Swinton and Pendlebury Board renewing its application to Parliament, if the necessary sanction of the ratepayers can be obtained; but opinion in the district seems to be that, after the fresh experience of the Eccles Local Board, the whole matter will be allowed to drop, and that for the present the Salford Gas Committee will be free from "excursions and alarms" in its out-districts.

LINCOLN CORPORATION GAS AND WATER SUPPLY.

The Annual Accounts.

The City Treasurer of Lincoln (Mr. J. S. Battle) has issued his abstract of accounts for the year ending March 25 last; and the following figures relating to the Corporation Gas and Water Departments have been extracted therefrom.

The capital account of the gas undertaking shows a total indebtedness of £191,330. On the credit side, the original cost of the undertaking is put down at £185,796; and the expenditure on new buildings, mains, and services, at £5334. The revenue account for the year gives a total of £36,761. The cost of the manufacture of gas was £18,195, and of its distribution £1123. A sum of £604 was expended in gas cookers and cost of fixing. Rent and rates amounted to £709; and the Corporation stock expenses were £172. The management cost £902. Interest on loans required £226; and £1333 was set apart to meet current liabilities—viz., for proportion of interest on loans and annuities. The interest on Corporation stock amounted to £4304; there had been transferred to the sinking fund a sum of £1991, and £5000 to the reserve fund; and the balance amounted to £1481. The credit side showed a balance from last year's account of £4350. The sale of gas brought in £23,632—viz., £21,731 for 173,850,430 cubic feet supplied to private consumers, and £1900 for 15,204,000 cubic feet used for public lighting, both being charged at 2s. 6d. per 1000 cubic feet. The rental of meters yielded £557; and of gas-cookers, £197. For residual products a total of £7484 was obtained. The sum of £459 represented the value of gas-cookers on hire and in stock, after allowing for depreciation at the rate of 20 per cent. There were 19,012 tons of common coal carbonized during the year. On March 25, there were 69,000 gallons of tar in stock, and 850 tons of coke and breeze. The reserve fund now amounts to £15,079.

Regarding the finances of the Water Department, the total receipts (including a balance brought forward of £727) were £9822; the principal item being £8992 from water and meter rents. The maintenance and working expenses amounted to £4822; the rents of the reservoir, &c., were £158; and rates and taxes absorbed £452. Interest on loans required a sum of £3918; and £1219 represented the amount paid on account of loans. A balance of £747 was due to the Treasurer. The capital account of the same undertaking shows that the purchase of the water-works originally cost £63,827, and that £42,608 had been since expended in the purchase of land, the erection of new buildings, additions, and extensions. The gross amount of loans obtained on the undertaking was £105,000, of which £14,952 had been repaid by instalments. The general district rate account was also repaid a sum of £3700 out of the revenue.

THE POSITION OF COAL AND TAR PRODUCTS.

Last Saturday's *Chemical Trade Journal* says that there is but little fresh to report in the tar products market; but a translation from the *Frankfurter Zeitung*, which they give perhaps more fully explains the situation. Referring to the realization of the pessimistic prognostications which appeared in its pages some time back, the German paper remarks: The general situation of the tar products market is at present in a still more unsatisfactory state than it was some time ago, especially in regard to benzol. This is the consequence of the unreasonable increase in the production of benzol from coke, for which the districts of the Rhineland-Westphalia and Upper Silesia in chief are responsible. In the Upper Silesian district, three large benzol manufactories have been built within as many years; while the production in the West of Germany has also considerably increased. In England the increased production has, if anything, been even more marked; and in consequence a correspondingly extensive falling off in prices has been experienced. In spite of the enormous demand which exists for benzol, and which undoubtedly has increased to a large extent, the disparity between the production and the consumption threatens to completely disorganize the market. The best proof of this is to be found in the fact that the price of benzol has already fallen to 37 marks. This enormous decline has necessarily reduced profits to a minimum, without, however, leading to any decrease in the production. The market is in a precisely similar position to that experienced in the iron trade some time back, when, in spite of the prevalence of bad years, producers seemed unable to effect any reduction in the output. The demand for other tar products has also experienced a similar retrogressive movement. The situation of the sulphate of ammonia market, however, taking all things into consideration, is as good as can be expected. With regard to the price of pitch and tar, they have for long enough shown a tendency to decline, a movement which must always be looked for with raw materials.

Electric Lighting for Heckmondwike.—The ratepayers of Heckmondwike have given their consent to a proposal of the Local Board to construct the necessary plant for lighting the town by electricity. It is computed that the cost will amount to about £6000.

The Price of Gas at Manchester.—A resolution was passed at the meeting of the Manchester City Council last Wednesday, requesting the Gas Committee to report as to the advisability of making a reduction in the price of gas to be consumed for any purpose except that of illumination, to take effect after the end of the current financial year.

Proposed Improvement of the Leeds Water Supply.—The Borough Engineer of Leeds (Mr. T. Hewson) is now busily engaged preparing plans for a number of works in connection with the water supply, which are estimated to cost altogether about £100,000. They include the extension of the Carlton reservoir, the laying of a new 10-inch pumping main to Bramley, and the formation of new service reservoirs at Harehills, Windy Hill, and Beeston.

The Coal Contracts of the Leeds Gas Committee.—The Gas Committee of the Leeds Corporation had under consideration yesterday week the tenders for the supply of coal for the gas-works from the 1st prox. to the 30th of June next. The quantity which will be required during that period is about 200,000 tons, including cannel. The tenders showed some reduction in prices, compared with those of last year; but the Committee only accepted tenders for a portion of the amount, believing that there will be a further reduction, and that they will be able to obtain lower rates.

The Quality of the Water Supply of the Metropolis.—The report of Messrs. Crookes and Odling to the Official Water Examiner for the Metropolis (General A. de Courcy Scott) on the quality of the supply during the past month, contains the results of their analyses of 182 samples. These show that the supply during August continued to be of excellent quality, the proportions of organic matter present, estimated alike by the combustion and oxygen processes, and by the degree of colour-tint, being, as now for some months past, extremely small. In the case of the Thames-derived supplies for example, the mean proportion of organic carbon amounted to ·115 part in 100,000 parts of the water; this being ·002 part in excess of the mean for June, and ·020 part in excess of the mean for July—minute differences of no practical significance. The maximum proportion of organic matter present in any single sample examined, was found to be identical with that of the previous month, or ·152 part in 100,000 parts—corresponding roughly to about a quarter of a grain of organic matter per gallon. The amount of organic matter found in the water furnished by the Chelsea Company was again exceptionally low; the mean proportion of organic carbon in that Company's supply and in the supply of the New River Company (or ·078 and ·079 part per 100,000 respectively) being to all intents identical. From time to time, in periods of flood or after violent rainfall, Messrs. Crookes and Odling find, in the course of their examinations of the daily supply furnished by the different Companies, an occasional sample which, when viewed in bulk, exhibits a distinct turbidity; and from some cause or another, one such instance was met with among the 175 samples examined last month. More often, but still only occasionally, samples are met with manifesting on careful examination through a depth of 2 feet, a slight deficiency in brightness. These samples they have been accustomed to class as "very slightly turbid;" but there was not a single sample of the water furnished last month by three out of the five Thames Companies which could be so classed.

THE METROPOLITAN WATER SUPPLY COMMISSION.

The *British Medical Journal* publishes a *précis* of some recent evidence given by Sir GEORGE BUCHANAN, the late Principal Medical Officer of the Local Government Board, on the subject of the Metropolitan Water Supply, before the Royal Commission at a special sitting.

Sir GEORGE BUCHANAN stated that, in his opinion, no adequate evidence was derivable from any known chemical or bacteriological tests whether water after filtration contained matters hurtful to the human species. This applied especially to epidemic outbreaks of typhoid fever, cholera, &c. Experiments made with water purposely mixed with typhoid or small-pox poison, had not, within his knowledge, been attended with any success. They had been made on behalf of the Board. Different chemists had, in 1889, reported on the specimens of the same water taken at the same time and place, as being "very free from organic pollution" and as affording "evidence of recent sewage pollution;" as being "colourless and nearly clear," and as being "faint green and slightly milky;" as being "quite suitable for drinking purposes," and as "not satisfactory as drinking water." There had been too many demands on the limited purse given to the Medical Department of the Local Government Board by Parliament to continue the water investigations of Dr. Dupré. Other things more pressing and urgent came upon the Department; and they were unable to continue these investigations as they ought to have done. And with regard to the question of the distribution of disease in connection with any of the London water supplies, Sir George Buchanan stated that, since the investigation in 1866 into the East London water supply, the Department had not had so much to do with the health of London, compared with what it had to do with the health of the provinces. Where there had been a curious piece of scandal—such as eels being found in water-mains—the Medical Department of the Local Government Board had been asked, as the only scientific sanitary department at the disposal of the Government, to investigate it. In that case, they found that the eels crawled up the banks. No one knew of this power of eels crawling up the banks, until one of the inspectors stated it. Then they had also had some occasion to find out some risks, as they thought, of the fouling of the water of the Thames above the intakes, from the condition of the subsoil in the Staines sanitary district. That was another danger which the Department thought was very probably being incurred by London; but they had not followed that up at all. It was a matter which probably the Committee would be interested in.

Lord BALFOUR OF BURLEIGH: We are very much interested in it; but we want to know how to investigate it.

Sir GEORGE BUCHANAN, continuing, said he thought there was nothing for it but to go and look after it on the banks of the Thames.

In reference to the question of whether it would be practicable and worth while for the Commission to try and see whether pathogenetic organisms could be recognized and identified in filtered London water, Sir George Buchanan expressed his opinion that, until they had more developed methods, it would be no use trying. He did not think there was anything practically available for the purposes of the Commission, but what might be called field observations—to go and see that what ought not to get into the water did not get into it. When water was once obtained from a polluted source, he did not attach final importance to the treatment of it; there was nothing for it but either to boil it or to leave it alone. His own house was within the Metropolitan area; but he did not use the water. Another danger to which he called attention was that, after the water had been delivered into the pipes from the Company as fit for consumption, it then ran a fresh risk altogether, and one that might be very formidable indeed. This risk was that which was incurred by the lateral insuction of water from broken and leaking pipes—the insuction into pipes that were let into common troughs with sewers, and so forth. Specific and serious instances traced to that source of risk had been brought to his knowledge. An epidemic in Wales, at a place called Mountain Ash, reported on in the seventeenth supplement to his Report to the Board for 1887, gave an account of a water supply sent to a number of villages. One branch of the water supplied distributed an enormous amount of typhoid fever; while the other branches went on their way doing no harm to anybody. A map he produced showed places red with dots of typhoid cases affecting one particular branch, the others being free. The story was well worth reading, and very interesting—at any rate, for those who cared to look at the investigations.

AN AMERICAN ENGINEER ON THE LONDON WATER SUPPLY.

To the various schemes which have been propounded from time to time for augmenting the water supply of London, another has now to be added. The author on this occasion is an American Engineer (Mr. E. Bates Dorsey, M.Am.Soc.C.E.); and he has given an outline of his proposals in the columns of *The Times*. It appears that some years ago, he was requested to make an examination and preliminary survey of the different sources that could be made available for the supply of water to London; and the outcome was a plan which, he claims, does not "require any radical change in the present system of supply, but can be made entirely supplementary to it, and can be cheaply and quickly added as the demands for additional water make it necessary. It is not necessary to build now, at heavy cost, monumental works that will not be required except for large future increase of population—to supply water to unborn generations."

The following are the conclusions at which Mr. Dorsey arrived: "(1) If possible, the water should be supplied by gravity. (2) It would not be advisable to take any more water from the Thames without the construction of large storeage reservoirs. (3) There are no good sites in the Thames Valley where large storeage reservoirs could be economically built. (4) Owing to the dense population in the Thames Valley, the water is not suited to domestic use, and, if possible, better should be provided. (5) The Cumberland lakes and the Welsh mountains are the only large sources of water that can supply London by gravity. (6) Owing to the shortness of distance and the facility of constructing works, the Welsh mountains will give the cheapest water."

Acting upon these conclusions, Mr. Dorsey examined the Welsh watershed thoroughly. He decided that the best sources from which to supply London with water by gravity were the Wye, Elan, Ithon, Yrfon, Edw, Lug, Teme, and other rivers in Central Wales. By providing the necessary storeage reservoirs, and after making ample allowance for compensation water, the rivers of Wales could be made to contribute at least 200,000,000 gallons daily by gravity to the supply of London. In Brecknockshire there are, he says, several rivers that are available. Before the final selection, these and their pipe-lines should be carefully surveyed. This line, if feasible, would require much less pipe. For the conveyance of the water, he recommends the use of large wrought-iron or steel riveted pipes, which are easily and quickly made and laid. They can be laid following the undulation of the ground, the same as the ordinary gas-pipe. Moreover, they will stand very heavy strain or pressure. By using these as inverted syphons, water can be safely and cheaply conveyed across deep valleys. These pipes have long been in successful use in California, the Western States of America, and Australia, giving entire satisfaction. When properly coated with an asphaltum composition, they appear to remain uninjured by rust. The main water-pipe—100 miles long—supplying San Francisco is made of riveted wrought-iron plates; and it has been in successful operation many years. There is now in operation in California many hundreds of miles of this description of pipe, supplying water for cities, irrigation, and mining purposes, in all cases giving complete satisfaction. It can be cheaply and quickly constructed and laid. Mr. Dorsey would advise the construction of the necessary reservoirs in the mountains of Wales, and convey the water from them in the wrought-iron or steel pipes to service reservoirs at Harrow-on-the-Hill, Edgware, Finchley, or any other place that may be selected, or to the present service reservoirs near London; the water being delivered by gravity at over 200 feet elevation above mean tide. If it should be desirable to economize in the cost, the water, he says, could be brought to the Cotswold Hills in canal and pipes as the engineers think best. At the western side of the Cotswold Hills, the pipes would discharge the water into a tunnel; and the tunnel discharge it into the headwaters of the Thames, to be taken out at any selected point below, near London, even at the present pumping-stations. This plan would save about 90 miles of pipe and canal, but would require the expense of pumping. Moreover, the pure mountain water would be intermingled with the impure Thames water. Probably satisfactory terms could be made with the Thames and Severn Canal to pass the water through the Cotswold Hills in their present canal tunnel; thus saving the cost of a new tunnel. In case these works should be constructed with the object of supplementing the present water supply system, the first pipe-lines would be laid of sufficient size to convey the first instalment of the supplementary water to be discharged into the headwaters of the Thames or into the London reservoirs, as decided. Whenever required, an additional supply could be obtained in the Welsh mountains, and discharged into the Thames or brought to London, but at somewhat greater average cost, as the first supply would naturally take the nearest and cheapest water. By these plans, he maintains that the water supply of London can be continually supplemented as the future demands make necessary; but by no other means can such a quantity of good and pure water be so cheaply and quickly supplied.

Since Mr. Dorsey's examination, the waters of the River Elan have been appropriated by the city of Birmingham. This, he remarks, is the ideal watershed, offering all the advantages that an engineer can ask. Either plan proposed would require a small tunnel through the Cotswold Hills, unless arrangements could be made with the canal, and perhaps a short and small tunnel under the Severn river. There are no great engineering difficulties in either of the proposed lines. There have been in successful operation in California for years several mining enterprises where the engineering difficulties of construction and maintenance were about the same as they will be here, although the quantity of water conveyed there is not more than half of that estimated in the proposed plans. Unless the watershed of Wales should in the future be largely appropriated by other cities, as Birmingham and Liverpool have done in the past, in Mr. Dorsey's opinion there need be no fear of London not being able to obtain an abundant supply of good pure mountain water, at a cost that will pay very large dividends on the investment, provided the water will be sold at the same price as now charged by the London Water Companies.

Messrs. Hassard and Tyrrell, MM.Inst.C.E., have written to point out that the scheme advocated by Mr. Dorsey is identical with their own Mid-Wales project as laid some months ago before the London County Council, excepting that they show how 300 million gallons daily can be obtained from the Welsh districts and be delivered into service reservoirs both on the north and south sides of London at an altitude of 300 feet above Ordnance datum. Their scheme, they remark, can also be supplemented from other sources, so as ultimately to provide for Metropolitan use 450 million gallons daily of the purest water. Some allusion was made to Messrs. Hassard and Tyrrell's proposals in the article on "Water and Sanitary Affairs" in the JOURNAL for Aug. 30.

Fatal Oil-Lamp Accidents.—A fatal lamp accident occurred at Old Brompton last Saturday week. Mary Charlotte Phelps, 52, a married woman, being of short stature, stood on a fender to turn up an oil-lamp which was alight on the mantelpiece, and, in doing so, pulled the vessel down on to herself. She was dreadfully burnt, and died in St. Bartholomew's Hospital on the following day.——An inquest was held at Birmingham last Wednesday on the bodies of James Ethridge, his wife, and two children, the four victims of a paraffin lamp accident at Grove Lane, Smethwick. The evidence showed that both Ethridge and his wife were in a drunken condition on the previous Saturday night. At the hospital he stated that, when getting into bed, he knocked over the lamp; but his wife asserted that the reservoir burst. They were horribly burnt. The parents ran into the street in flames; but the children were rescued by the police after several gallant attempts. The jury returned a verdict of "Accidental death."

THE PROPOSED NEW SOURCE OF WATER SUPPLY FOR GLOUCESTER.

The vexed question of an additional source of water supply for Gloucester still appears to be a long way from settlement. Report after report has been submitted to the Water Committee on the subject; and, in the hope of arriving at something definite, they resolved to lay the various documents before Mr. James Mansergh, C.E., for his opinion thereon. This gentleman's report has lately been before the City Council; and in it he recommends still further investigation. He concludes the report by saying: "I am not prepared to advise that water should be pumped from the Severn—there is a justifiable objection in the minds of the public to such a source; and I am not hopeful that a good and permanently-sufficient supply could be obtained from the substratum of gravel in the flat lands of the main valley. Under these circumstances, I have come somewhat reluctantly to the conclusion that of all the schemes referred to in Mr. Fox's report, the one he has first recommended is the one that should receive further attention—viz., pumping from the Red Sandstone near Newent. I feel, as all previous reporters have manifestly felt, the extreme difficulty of the inquiry; and I regret my inability to make a strong definite recommendation without any reservation. I believe it is almost certain that a large quantity of water will be found in the red sandstone; but there are always contingencies about underground supplies—the distance from Gloucester is great; and there is no convenient site at suitable elevation for a service reservoir. I think it would be well before coming to a final decision that you should commission Mr. Fox to make a further investigation in the hope of his being able to suggest some other scheme less open to objection than the best of those now reported upon. Meanwhile, it would be desirable, in order to save time, that a trial boring should be put down near Newent, so as to test the quality of the water and so far as possible the quantity procurable. I think the spot selected by Mr. Etheridge is a good place. Probably you are aware that an experiment on a large scale is being made at Worcester in the use of Dr. Anderson's water-purifying apparatus as applied to Severn water, in conjunction with subsidence and sand filtration; and it may be worth while to make inquiry as to the results, if you think the popular adverse sentiment can be overcome. Although I mention this, I could not personally, with my present lights, recommend the setting up of new works, taking water from a river draining 3700 square miles of country, the greater part of which is highly cultivated and manured, and has upon it a very considerable population." The Water Committee stated that they had forwarded a copy of Mr. Mansergh's report to Mr. Fox for his observations thereon. In his reply, he said that he understood, provided the quantity and quality of the water at Newent was satisfactory, that the only objection to the scheme was the distance that the service reservoir would be from Gloucester. It might be possible to remedy this by placing the service reservoir on Robin's Wood Hill; but he had not examined this place to see if a suitable site could be obtained. He pointed out that the city was now supplied direct from Witcomb, which was about 5½ miles off; whereas the site he proposed was only 2½ miles farther. In the event of the boring at Newent not giving a satisfactory result, the question of an alternative source of supply would naturally arise; and, speaking for himself, he could see no alternative but the Severn. The reports were not discussed.

The Proposed Acquisition of the Todmorden Gas-Works by the Local Board.—We reported a few weeks ago that the Todmorden Local Board had decided to purchase the whole of the gas interests in their district for £103,362 10s.—equal to 18½ years' purchase of the average profits of the concern; and that, at a statutory meeting of ratepayers, a resolution agreeing with this decision was carried by an overwhelming majority, but a poll was demanded. This has now been carried into effect, with the result that 2661 votes were recorded in favour of the purchase, and only 530 against. Evidently a large number of ratepayers in the district do not feel greatly interested in the matter, as no less than 1161 papers were unsigned.

The Thirlmere Water-Works of the Manchester Corporation.—The members of the Manchester Corporation last Wednesday week paid a visit to the Thirlmere Water-Works; and, in connection therewith, some interesting particulars have been published as to their present position. The area of the lake is now 328½ acres; and, when it is raised 50 feet, it will cover 793 acres. Its capacity will then be 8,130,686,693 gallons. The rainfall over the watershed varies from 52 to 137 inches a year. The water will be conveyed to Manchester in the following manner: By tunnels, 13 miles 1410 yards; by "cut and cover," 37 miles 1219 yards; and by cast-iron pipes (48, 40, and 36 inches in diameter), 44 miles 495 yards. The diameter of the aqueduct is 7 feet; and the fall is 20 inches per mile. When all the works are completed, there will be a yield of 50 million gallons of water per day for 150 days, even if no rain falls during that period. It is not the intention of the Committee, however, to bring the whole of this vast volume of water to the citizens of Manchester at once. The arrangements provide for the laying of five lines of pipes, each of which will convey 10 million gallons per day; and it is intended to bring the supply by instalments of 10 million gallons a day at such intervals of time as may be found necessary. The watershed, including the lake, extends over an area of 11,000 acres. The purchase of this great tract of country, together with the cost of the wayleave for the tunnels and "cut and cover," the laying of five lines of syphon-pipes across the valley, and the works as being carried out at present, will reach about £2,500,000. These works include all the tunnels and "cut and cover" to convey 50 million gallons per day, and one line of pipes to convey 10 million gallons per day to Manchester. When the five lines of pipes have been laid, and the lake raised 50 feet, it is estimated that the cost will be between £4,000,000 and £5,000,000. The land arrangements were in a sufficiently advanced state to enable the preparation of the works for letting to be proceeded with in 1884; and the first contract in connection with this great undertaking was let at the end of the year 1885.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Material out of which to compile my usual budget of "Notes" is scarce this week. Subjects of interest do not seem to have cropped up, unless I were to chronicle such items as that the Dundee Gas Commissioners have secured their first important contract for electric lighting, in an order by the Eastern Club to light up a portion of their premises at a cost of £90 odd a year, notice of which has been carefully circulated as a sort of advertisement of the business, or decoy-duck to other possible customers. Or I might chronicle how the bravado Police Commissioners of the small town of Dufftown, in Banffshire after allowing their gas-works to be extinguished by a local distiller, and talking big about introducing electric lighting, have at present no public lighting whatever, and have resolved to have the streets lighted by oil-lamps. There is also another item I might mention, that the Corporation gas undertaking in Forfar, after leading a somewhat chequered existence for some years, having lost a good deal of business by the establishment of private electric lighting installations in mills, has again begun to look up, and that the monthly returns of gas consumption are showing increases. This latter circumstance, while it must be gratifying to the Corporation, but bears out the expectations which they have all along undauntedly held of the vitality of their business. These items, however, are not of surpassing interest; and I am afraid I must cast myself on your indulgence if I do not manage to make this week's "Notes" so satisfactory as I should like them to be.

A meeting of the Edinburgh and Leith Gas Commissioners is called for Monday next, at which Mr. Wells, of Leith, is to submit a motion proposing that the Works Committee should consider the expediency of procuring ground on which to erect experimental works, where the respective qualities of coal might be tested under identical conditions—such as size of retort, system of setting, &c.; and that the Committee be asked to consider the advisability of choosing and recommending to the Commissioners, for purchase, a piece of ground of sufficient area for the erection of new works, for the deposit of residuals, or for any other purpose. It is difficult, and in a sense scarcely fair, to criticize a motion before hearing what is to be said in support of it. I may, however, point out that this is a double, if not a triple-barrelled proposal. The establishment of experimental works is a strong point with Mr. Wells; but he seems to go further in this motion, and to wish for new works altogether, or, if not that the works should be entirely transferred, that at least there should be a new works of some sort erected. This may be the "any other purpose" he contemplates. As Mr. Wells has been for some time engaged in assisting in experiments with oil-enriching in the Leith Gas-Works, it is just possible that what he has in view under that general phrase may be the erection of an oil-gas works, or a works where better provision may be made for enriching processes. Whatever his proposals may turn out to be, I can assure him that they will meet with stout opposition. The Commissioners are in no mood for further expenditure of money. Their aim at present—and it is likely to be so for some years—is to get the price of gas down as far as possible. Doubtless Mr. Wells may be able to show that his proposals would lead to ultimate gain; but the notion of the Commissioners is that what is needed is immediate relief from the disadvantageous pressure of the present high price of gas, and not the incurring of further capital outlays—even with prospective gains. Still, anything which Mr. Wells proposes, is certain to receive the respectful consideration which is due to whatever is brought forward by a gentleman of so much practical experience as he is.

The Glasgow Gas Commissioners have gone into the market to procure a supply of coal for the six months from Oct. 1. They are likely, in the present state of the coal trade, to have large offers, and consequently to secure favourable contracts. The Corporation manage this department of their work well. They have been exceedingly fortunate in their past purchases; and the times look auspicious for them now.

In Aberdeen, the Gas Committee of the Corporation have just concluded contracts for the balance of 14,000 tons of coal required for the year. These they have secured at an average cost of 19s. 10d. per ton, for coal to produce 24·20-candle power gas. The Corporation, like some others, only contracted for a portion of their year's supply in the early part of the summer; their expectation being that they would get coal cheaper now. They have not been able to do that, so far as price is concerned—the summer contracts having been at an average of 19s. 6d. per ton; but the quality of the coal which has just been contracted for appears to be better, which means an actual saving in the matter of price.

The Greenock Police Board on Tuesday had before them the question of how they were to deal with the gas undertaking during the current year. They fixed the price of gas at 3s. 4d. per 1000 cubic feet, the same as last year. Then they tackled the subject of how much, in their folly, they were to exact from the gas undertaking. A Committee recommended that they should fix the sum at £1500. Several proposals were put forward—one that the contribution by the Gas Department to the town's funds should be £1000, another that it should be £750, and a third that it should be £500. Ultimately the sum was fixed, on the motion of Provost Rodger, at £750. The contribution by the Gas Department for the past year was £1427; and it was paid out of the contingent fund. Next summer, I suppose, unless the gas undertaking should show a profit, the same thing will happen. Whether there be a profit or not, the system is a pernicious one, and cannot be too strongly condemned.

The Town Council of Stirling are again about to be moved on the subject of acquiring the undertaking of the local Gas Company. Notice of motion to that effect was given at a meeting of the Council on Monday night. Last year a Special Committee of the Council had the same subject in hand; but they allowed it to drop. The proposal now is that they should consider whether they ought not to adopt the Burghs Gas Supply (Scotland) Act of 1876. The spirit of earnestness, or, perhaps, honesty of the motion, is seen in the statement that it was brought forward with the object of getting information which had been refused by the Gas Company. The season of the year also points in

the direction of there being no serious intention of taking over the undertaking. It is now near the end of September; and there is no time to take the opinion of the ratepayers so as to allow of anything being done this season. The proposal has, therefore, every appearance of being intended for another purpose than what it professes to be; and probably that purpose is more to humbug the Gas Company than anything else. The Company should hold their ground, and give no facilities until they see a straightforward proposal made.

Another of those "bloated" companies which have for the past year or two been fattening at the expense of the gas manufacturer, has held its annual meeting this week. The Rosewell Gas Coal Company, who own works in Fifeshire, has been able to pay a dividend at the rate of 20 per cent., and a bonus of 10 per cent. The capital of the Company is £23,300; and the income for the past year was £11,613. Last year, the Chairman said, they raised 31,000 tons of cannel coal, which was 7000 tons over the previous year. If a profit of £11,000 can be made upon 31,000 tons, it requires very little calculation to find out how much gas undertakings are being overcharged for coal.

For the past two years it has, unfortunately for gas consumers, been too often their lot to read of increases in the price of gas. The tables seem now to be turned, and decreases are the order of the day. The latest I have seen announced is that of the Newport Gas Company, in Fifeshire, which has reduced its charge from 5s. 10d. to 5s. 5d. per 1000 cubic feet.

The Edinburgh and Leith Water Trust have imposed the same rates this year as last—viz., 5½d. per £1 of a domestic rate, 2d. per £1 upon shop rentals, and 1d. per £1 over all for public purposes. The total rental of the district is £2,279,653; and the sum estimated to be raised by rates is £81,846. The total income is estimated at £84,218. Mr. Colston, in moving that the assessments be as above, said that last year their estimated receipts were £87,108; and the actual receipts, £87145. They had spent £1844 in connection with inquiries as to new sources of supply; and this year they estimated an expenditure of £2500 on the same head. The Lord Provost having expressed a wish that they should be able to fix a rate which would be permanent, and to avoid the raising and lowering of the rates, as was sometimes required, Mr. Colston pointed out that this matter was regulated by statute, which also required them to form a sinking fund which went to posterity. This year their contribution to the sinking fund would be £11,231. That was equal to 2d. per £1; and were it not for the sinking fund, their domestic rate would be as low as 3½d. per £1. This brought up Bailie Archibald, who is the principal mover in the proposal for the introduction of an additional water supply. He regarded it as settled, by the fact of their expending £2500 this year upon inquiries, that they were agreed upon a further supply being necessary. If they had last year retained the domestic rate at 6d. per £1, they would have had £4000 in hand, which would have almost met the interest upon £100,000. The past year showed that with a 6d. rate they would be able to bring in an additional supply without raising the rates; and he deprecated their fixing a low rate just now when they knew that they would have to raise it again in a few years. The Bailie is doubtless right logically, when he contends that it would be easier upon the community to have accumulated a fund out of which to meet the charges for the new supply; but it would have been illegal, as the Trust are bound to raise only what is sufficient for the year.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Sept.* 24.

Sulphate of Ammonia.—The strong demand for spot parcels conduces to the continuing firmness of the market; and, for immediate delivery, enhanced prices have again been paid. It has become evident that the present production can hardly cope with the requirements. All stocks being cleared, we have the almost unprecedented fact before us that there is not sufficient sulphate to supply the demand, should it continue on the present scale; and it would indeed be a novelty, after such a long period of dulness, to experience a famine in sulphate. Clearly the German consumption has been exceptionally large this autumn, refuting the statement that autumn manuring was gradually being given up in that country. Both France and Belgium appear to be awakening to the fact that they have missed their opportunities; for, looking at the present position, the chances of a relapse seem very remote. Consumers generally also realize this. Their extreme caution in putting out feelers as regards "futures" indicates their anxiety; and, as it will be some time before the production expands largely, the strong position may reflect further upon values. To-day's quotations are £10 2s. 6d. to £10 5s.; and there are hardly any sellers for forward delivery. Nitrate keeps steady.

LONDON, *Sept.* 24.

Tar Products.—Notwithstanding the influential efforts that are being made to improve some of the leading products, so far there is no enhancement in their value. Anthracene continues weak and unsaleable; and most distillers are running into stock, rather than accept the low prices at which it is now valued. Whether this is a wise policy remains to be seen; but, as far as the more immediate future is concerned, there is no prospect of improved prices, owing to the utterly collapsed state of the dye and printing industries. Benzols are firm at the prices quoted below; and it is not so difficult to effect sales, as was the case a few weeks back. Carbolic acid disinfectants are weaker. But there is little doubt that the market has been completely denuded of stocks that were formerly existing; and it is thought that, when this becomes recognized, the price will again advance, especially if it be found that much that has been sold has been done by speculators who have not covered. The following prices have obtained during the week: Tar, 9s. to 10s. Pitch, 27s. Benzol, 90's, 1s. 7½d.; 50's, 1s. 3½d. Toluol, 1s. 1½d. Solvent naphtha, 1s. 1½d. Crude benzol naphtha, 30 per cent., 7d. Creosote, 1¼d. Creosote salts, 20s. Pressed naphthalene, 40s. Carbolic acid, 60's, 1s. 7½d.; 70's, 1s. 10d.; crystals, 6½d. Cresol, 1s. 8d. Anthracene, 30 per cent., "A" quality, 9d.; "B," quality 6½d.

Sulphate of Ammonia.—A good deal better feeling obtains in this market; and important business has been transacted at prices ranging, according to position, from £9 17s. 6d. to £10 5s. per ton, less 3¼ per cent. The demand at the moment appears to be excellent; and the improved values, coming as they do just as the consumption is beginning to become accentuated, it is hoped that sulphate will see better prices again. Gas liquor (10-oz.) is quoted at 6s. to 7s. per ton.

COAL TRADE REPORTS.

Lancashire Coal Trade.—Business generally throughout the coal trade of this district continues slow. Supplies of the better qualities of round coal are still plentiful; and many of the collieries are not working more than four days per week. Prices remain without quotable change, except that they are gradually hardening up to list rates. Best Wigan Arley, however, still does not average more than 12s. to 12s. 6d.; Pemberton four-feet and second qualities of Arley, 10s. to 10s. 6d.; and common house-fire coals, 8s. 6d. to 8s. 9d. per ton, at the pit mouth. All other descriptions of fuel are moving off only indifferently; and inferior sorts, both of common coal and engine fuel, are more or less a drug in the market, with prices tending downwards. Requirements for iron-making and steam purposes, still show no improvement; and at the pit mouth, steam and forge coals do not average more than 7s. 6d. to 7s. 9d. per ton. Engine fuel is more plentiful; and in the expectation of lower prices, consumers are buying only from hand to mouth—contracts being only offered at a substantial concession upon current rates. Prices are, if anything, easier. At the pit mouth they do not average more than 6s. 3d. to 6s. 6d. for good qualities of burgy; 5s. to 5s. 3d. for the best qualities of slack; 4s. to 4s. 3d. for medium sorts; and 3s. 3d. to 3s. 6d. for common slack. The shipping trade continues depressed; and large quantities of coal are sent on speculation to the ports on the Mersey, where they have to be sold at any price they can realize—many of the sidings being completely blocked. Delivered at the Garston Docks or the High Level, Liverpool, ordinary descriptions of steam coal do not average more than 8s. 6d. to 8s. 9d. per ton.

Northern Coal Trade.—There is less animation in the coal trade of the North. During the past few days, heavy shipments have been made to the Baltic; but the season there is believed to be tapering off. Best Northumbrian steam coal is fairly steady, at from 10s. 3d. to 10s. 6d. per ton f.o.b.; but second classes of coal are easier, at from 9s. to 9s. 6d. per ton. Small steam coals are abundant, and sell at from 3s. 9d. to 4s. 3d. per ton. Gas coals vary much in price. But the deliveries are increasing, both for shipment and for local consumption; and some of the large users are evidently stocking coal freely. The price varies from 7s. 9d. to 8s. 6d. per ton f.o.b. for odd cargoes; but the largest deliveries are now being made on contracts, the prices of which range from 7s. 6d. to as high as 9s. per ton—those at the latter price having usually been entered into for this year's supply at the end of the past year. Bunker coal is in very abundant supply; and the price that has been taken is as low as 6s. 9d. per ton for unscreened qualities, whilst for the best Durham screened as high as 10s. per ton is quoted. Manufacturing coal is quiet; but there is a good demand for smithy coal. In coke best makes of Durham, for blast furnaces, command 13s. 6d. per ton at the furnaces, or 15s. to 16s. per ton f.o.b., according to quality. Gas coke is rather quiet; the output now beginning to enlarge, and stocks to increase.

Scotch Coal Trade.—No change has characterized the course of trade during this week. In the west, where the home consumption is most restricted, the dulness which has set in is most felt. The demand is so little that in some instances miners are getting no more than three days' work a week, while four days a week is almost universal. Even with this restriction, the railway sidings are getting blocked with loaded waggons, for which there appears to be no outlet. Some idea of the almost deplorable state of trade may be gathered from the statement that there are at present 15,000 Clyde shipbuilding hands idle. Shipping orders are still being worked off, which gives an appearance of healthiness to the trade that it does not in reality possess. Fresh orders can scarcely be secured; and the market quotations are to some extent delusive, because they are more the prices asked than those which are accepted. A decrease in miners' wages is being spoken of. But there is not unanimity on the subject; some coalmasters being averse to entering into conflict with their men. It is significant that the men themselves are exceedingly quiescent in the matter, as if they were fully alive to the hopelessness of resisting a reduction were it proposed. Only in Fifeshire are they at all attending to the work of organization; and, as a matter of fact, that is the only place which has not yet felt the pinch seriously. The prices quoted are: Main, 6s. 10d. to 7s.; ell, 8s.; splint, 7s. 6d. to 7s. 9d.; and steam, 9s. 6d. to 9s. 9d. per ton. The shipments were 174,980 tons; an increase of 12,389 over the quantity of the preceding six days, and of 21,740 tons over the corresponding week of last year. A great deal of the increase was from Glasgow. For the year to date, the total shipments have now reached 5,388,651 tons—an increase over the same period last year amounting to 659,700 tons.

Partial Failure of the Electric Light at Hastings.—We learn that last Thursday twelve out of the fifteen arc lamps in use on the parade at Hastings, and all the pier electric lights, were out for more than an hour. Fortunately, however, gas is also in use on the pier; and the small gas-lamps which are still retained on the parade were alight at the time of the electrical failure. The place was therefore not plunged entirely in darkness.

Stoking Machinery and the Hours of Labour at the Keighley Gas-Works.—Stoking machinery has been recently introduced into the Keighley Corporation Gas-Works; and, in consequence, there has been some alteration in the rates of pay and hours of labour. With the exception of the men actually in charge of the machines (who remain on the same terms as before), the shift has been increased from eight to twelve hours. The men do not consider that the lessened hardship of their work will compensate for the increase of 50 per cent. in the hours; and they have asked the Gas Committee to reconsider the matter.

The Supply of Natural Gas in Ohio.—Ground has been broken by the North-Western Ohio Natural Gas Company for an immense pumping plant near Van Buren (Ohio), to be used for forcing natural gas to cities supplied by that Company. The pressure has become so reduced that the Company can no longer convey the necessary amount of gas to supply their customers; and they are now compelled to resort to pumps to create an artificial pressure. The step is a very important one, as, if successful, it will be possible to draw out every foot of gas in the field. The plant, it is estimated, will cost £15,000.

Sale of Shares.—An important sale by auction of gas and water shares took place at Durham last Wednesday. Some original £10 shares in the *Durham Gas Company* realized £20 2s. 6d.; new £10 shares, £14 10s.; and fourth issue shares, £7 15s. A considerable number of £5 shares (various issues) in the *Consett Water Company* sold at prices ranging from £8 17s. 6d. to £9 5s. Shares in the *West Hartlepool Gas and Water Company* produced as follows: £5 "A" shares, £10 6s.; £5 "C" shares, from £8 6s. to £8 16s.; £10 "D" shares, £15 5s.; and "D" shares of the new issue, £8 4s. Several shares in the *Weardale and Shildon Water Company* fetched from £30 2s. 6d. to £37 6s.

The Divining-Rod.—A paragraph has been published in several provincial papers, in which it is stated that another instance of the successful use of the divining-rod has occurred at Buxton, where Mr. H. R. P. Lomas, the proprietor of the largest hydropathic establishment in the town, has by its means secured an excellent supply of water to his premises. The water-finder was Mr. John Mullins, of Chippenham, Wilts, who, after using the rod, recommended sinking operations at a certain point. At a depth of 60 feet, the workmen tapped an exceptionally fine stream of water—one of the strongest springs Mr. Mullins has found—yielding over 4000 gallons per hour. The sinking operations involved the blasting of between 30 and 40 feet of black rock full of flint.

The Quality of the Water Supply of Chester.—The Bishop of Chester has addressed a long letter to the Duke of Westminster (who is President of the Chester Infirmary) regarding the quality of the water supplied from the Dee. He says there is an overpoweringly strong case for a thorough investigation by eminent and impartial experts; and if the Water Company will not take steps to clear in open court the character of the water they are privileged to supply, the Local Government Board ought to be approached with an emphatic representation on the subject. If the experts pronounce a reassuring verdict, all parties will then be satisfied. A public meeting of the ratepayers of the city (at which the Duke of Westminster will preside) is to be held next Friday to discuss this subject.

Oil *v.* Gas at Torpoint.—The ratepayers of Torpoint have been much exercised of late over the question of the lighting of the streets. The Gas Company's tender for supplying gas and lighting and extinguishing the lamps is £2 10s. 8½d. each—which is an increase on the previous price. It has been suggested that an oil scheme should be adopted, which would necessitate a 5d. rate; being 1d. less than would be required for gas. A public meeting has been held to discuss the matter, and a resolution was carried adopting the oil scheme; but last week the gas partisans presented a requisition (signed by 91 ratepayers) to the Lighting Inspectors asking them to light the town by gas until the next Vestry meeting, to be held in January. This the Inspectors have determined to do; but, in the meantime, three oil-lamps are to be fixed as an experiment.

Conviction of a Water Company for Neglecting to Supply Water.—At the South-Western Police Court last Wednesday week, a case was heard by Mr. Hopkins, in which the Southwark and Vauxhall Water Company were summoned for unlawfully neglecting and refusing to furnish to Miss Charlotte Armiger, a confectioner, of High Street, Wandsworth, a supply of water, she being entitled to such supply—the rates for the same being duly paid or tendered. Mr. Crawshaw appeared for the complainant; and Mr. Lynch defended. The complainant stated that she had occupied the premises in question for two years, and had nothing to complain of in the matter of water supply until Aug. 23, when she suddenly found herself without water. Being ignorant of the right method of procedure, she did not (as she ought to have done) write to the Company at once, but communicated with the landlord's agent. Failing to get satisfaction, she ultimately, on Aug. 30, wrote informing the Company that her water had been cut off. She received a reply, stating that the matter should be inquired into. A man visited the house, but nothing was done to reconnect it with the main until the summons was issued last week. In cross-examination, complainant said she did not know until now that she obtained her supply through her neighbour's pipe. She had paid her rates up to Midsummer, and had received no further demand. The defence was that complainant's neighbour, from whose pipe she had, unknown to the Company, procured her supply, requested them to cut off his water, in order that constant-supply fittings might be provided—the consequence being that Miss Armiger found herself without water. Mr. Hopkins wished to know whether he understood rightly that the Company had taken money for a supply without knowing how the consumer obtained the water. Mr. Lynch said that was so. The Company also urged that, even if the Magistrate was against them on that point, the summons must fail, as the rate had not been paid or tendered in advance. Mr. Hopkins, in giving his decision, said, although Water Companies had power to claim their rates in advance, most of them never exercised that right, except where they expected to have trouble in getting their money. Therefore, for all practical purposes, they waived their right. When their attention was called to this matter, the Company certainly neglected for eight days to supply water, and then they said they did not know they had cut off the supply in putting in fresh fittings to the next house, although they had been taking payment from Miss Armiger for two years. All he could say was that this was a regular Water Company's defence, for which there was no sort of justification. He imposed a penalty of £10, and £1 a day for the eight days during which complainant was without water after giving the Company notice. Last Wednesday Mr. Lynch made an application on behalf of the Company for a case for the consideration of the Superior Court; and it was granted.

The Water Supply of Devonport.—It is such an exceptional thing for local authorities to show that they are satisfied with the manner in which water companies discharge their duties, that we feel impelled to record the following resolution passed at a special meeting of the Devonport Borough Council last Thursday week: "That a letter be sent to the Devonport Water-Works Company, expressing the Council's hearty appreciation of the steps taken by Mr. H. Francis, Assoc.M.Inst.C.E., the Company's Engineer, to keep the town supplied with a constant supply of water during the recent drought."

New Water-Works for Nelson.—Last Wednesday, the new works in connection with the Nelson water supply were formally opened by the Mayor (Alderman Wilkinson). These consist of a compensation reservoir, constructed at the foot of Pendle Hill, about five miles distant from Nelson; and two filter-beds in the Ogden Valley. The reservoir which has a capacity of 40,000,000 gallons, was commenced about 18 months ago. It impounds the Black Moss stream, and is the first of a series of reservoirs to be constructed by the Corporation under an Act obtained four years ago. The filter-beds, which are situated at an elevation of 900 feet above the sea-level, have each a capacity of 700,000 gallons; and, by a 10-inch main leading into them from the Ogden stream, 600,000 gallons can be admitted to the beds daily. The same quantity of water (equal to about a day's consumption in Nelson, Brierfield, and Barrowford, all of which places come within the district supplied with water by the Nelson Corporation) can be withdrawn from the beds daily, and taken into direct use. In addition to this source of supply, the Corporation are possessed of two service reservoirs, with a combined accommodation for 85,000,000 gallons. The sanction of Parliament is also obtained for the construction, when necessary, of two reservoirs, each to hold 40,000,000 gallons, on the Ogden stream above the filter-beds, and another to contain 180,000,000 gallons at a lower level than the beds. The scheme when completed will place the Nelson Corporation in a position to supply a population of 100,000 with an abundance of good water. As compensation for the appropriation of the Ogden stream, the Corporation will be required to construct, when the necessity arises, in addition to the existing compensation reservoirs, another near the one just completed. The cost of the new reservoir is about £10,000. It was designed, together with the filter-beds, by Mr. John Newton, of Nelson; and the work has been carried out by Messrs. Etheridge, Clark, and Co.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 544.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	13 Apr.	10½	Alliance & Dublin 10 p. c.	10	16—17	..	6 3 6
100,000	10	,,	7½	Do. 7 p. c.	10	11—12	..	6 5 0
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	103—105	..	4 15 3
100,000	20	27 May	8	Bahia, Limited	20	10—12	..	13 6 8
200,000	5	12 May	7½	Bombay, Limited	5	6—6½	..	5 15 9
40,000	5	,,	7½	Do. New	4	3¼—4¼	−¼	7 1 3
380,000	Stck.	12 Aug.	12½	Brentford Consolidated	100	212—217	..	5 10 7
150,000	,,	,,	9½	Do. New	100	163—168	..	5 10 1
220,000	20	15 Sept.	11½	Brighton & Hove Original	20	40—42½	..	5 9 6
888,500	Stck.	31 Aug.	5	Bristol	100	95—100	..	5 0 0
320,000	20	13 Apr.	11½	British	20	42—44	..	5 2 3
50,000	10	31 Aug.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	,,	8½	Do. 7 p. c.	10	14—16	..	5 6 3
328,750	10	—	—	Buenos Ayres (New) Limited	10	6—7	..	—
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	92—95	..	6 6 4
150,000	20	12 Aug.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	13 Apr.	13	Commercial, Old Stock	100	235—240	..	5 8 4
165,000	,,	,,	10	Do. New do.	100	185—188	+1	5 6 4
160,762	,,	15 June	4½	Do. 4½ p. c. Deb. do.	100	123—128	..	3 10 4
800,000	Stck.	15 June	10	Continental Union, Limited	100	223—228	+1	4 7 8
200,000	,,	,,	7	Do. 7 p. c. Pref	100	185—195	..	5 3 7
75,000	Stck.	15 Sept.	10	Crystal Palace District	100	180—185	..	5 8 1
486,090	10	28 July	10	European, Limited	10	19½—20½	..	4 17 7
354,060	10	,,	10	Do. Partly paid	7½	14—15	..	5 0 0
5,470,820	Stck.	12 Aug.	12	Gaslight & Coke, A, Ordinary	100	216—221	..	5 9 1
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	95—98	..	4 1 7
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	255—260	+3	3 16 11
30,000	,,	,,	5	Do. F, 5 p. c. Pri.	100	116—121	..	4 2 7
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	166—171	..	4 7 8
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	162—167	+2	4 3 10
463,000	,,	,,	10	Do. I, 10 p. c. Prf.	100	253—258	+1	3 17 6
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	150—154	..	3 17 11
1,061,150	,,	15 June	4	Do. 4 p. c. Deb. Stk.	100	117—119	+1	3 7 3
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	120—124	..	3 12 7
908,000	,,	,,	6	Do. 6 p. c. do	100	164—169	..	3 11 0
3,800,000	Stck.	12 May	12	Imperial Continental	100	226—231	..	5 4 4
75,000	5	15 June	6	Malta & Mediterranean, Ltd.	5	3¾—4¼	..	7 1 8
560,000	100	1 Apr.	5	Met. of Melbourne, 5p. c. Deb.	100	108—110	..	4 10 11
541,920	20	15 June	5	Monte Video, Limited	20	12—13	..	7 13 0
150,000	5	27 May	10	Oriental, Limited	5	8½—8¾	..	5 14 3
60,000	5	30 Mar	7	Ottoman, Limited	5	4—5	..	7 0 0
166,870	10	—	2	Pará Limited	10	1½—2½	..	—
420,000	100	3 May	6	People's Gas of Chicago— 1st Mtg. Bds.	100	106—110	..	5 9 1
500,000	100	1 June	6	2nd Do.	100	100—103	..	5 16 7
150,000	10	—	10	San Paulo, Limited	10	6½—7½	−½	—
500,000	Stck.	31 Aug.	15½	South Metropolitan, A Stock	100	272—277	..	5 6 3
1,350,000	,,	,,	12	Do. B do.	100	227—232	+2	5 3 5
230,000	,,	,,	13	Do. C do.	100	240—245	..	5 6 1
725,000	,,	14 July	5	Do. 5 p. c. Deb. Stk.	100	140—144	..	3 9 6
60,000	Stck.	31 Aug.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
743,952	Stck.	1 July	10	Chelsea, Ordinary	100	245—250	..	4 0 0
1,720,252	Stck.	13 Apr.	8	East London, Ordinary	100	196—201	..	3 19 7
544,440	,,	1 July	4½	Do. 4½ p. c. Deb. Stk.	100	140—144	..	3 2 6
700,000	50	1 July	8½	Grand Junction	50	99—103	..	3 17 8
708,000	Stck.	12 Aug.	11	Kent	100	260—265	..	3 19 3
1,043,800	100	1 July	9½	Lambeth, 10 p. c. max.	100	215—220	..	4 6 4
406,200	100	,,	7½	Do. 7½ p. c. max.	100	190—194	..	3 17 3
879,700	Stck.	30 Mar.	4	Do. 4 p. c. Deb. Stk.	100	123—128	..	3 2 6
500,000	100	12 Aug.	12½	New River, New Shares	100	320—330	..	3 13 6
1,000,000	Stck.	28 July	4	Do. 4 p. c. Deb. Stk	100	127—130	+1	3 1 6
902,300	Stck.	15 June	6½	S'thwk & V'xhall, 10p. c. max.	100	144—149	..	4 7 3
126,500	100	,,	6½	Do. D 7½ p. c. do.	100	134—138	..	4 14 3
1,155,066	Stck.	15 June	10	West Middlesex	100	236—241	..	4 3 0
						*Ex div		

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM LONDON."

GWYNNE & CO., TELEPHONE No. 2698.

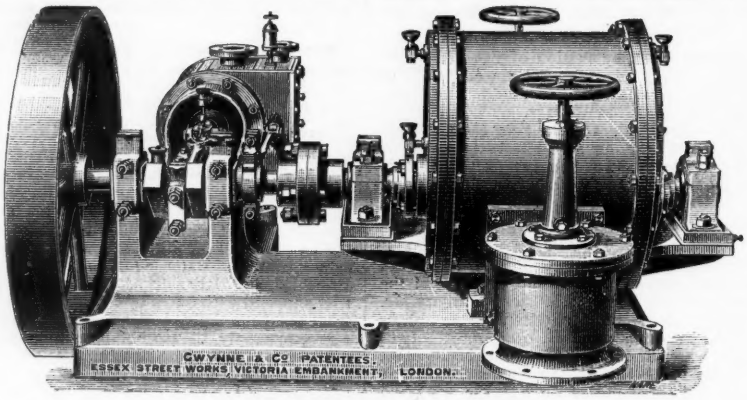
HYDRAULIC AND GAS ENGINEERS, ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C.

Thirty-three Medals at all the Great International Exhibitions have been awarded to GWYNNE & Co., for Gas Exhausters, &c.

They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality.

The result is that in every instance their work is giving the fullest satisfaction.

They have completed Exhausters to the extent of 30,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work, and can be referred to.



Engine and Exhauster Combined on One Bed-Plate.

GWYNNE & Co.'s Exhausters are constructed of large size to pass the required quantity of Gas at very slow speeds; the wear and tear being reduced to a Minimum.

Catalogues and Testimonials sent on Application.

Their Exhausters can be made, when desired, on their New Patent Principle, to pass Gas without the slightest oscillation or variation in pressure.

NO OTHER MAKER CAN DO THIS.

Makers of GAS-VALVES HYDRAULIC REGULATORS, VACUUM GOVERNORS, STEAM-PUMPS for Tar, Liquor, or Water; PATENT SELF SEALING AND CLEANING RETORT-LIDS AND MOUTHPIECES; CENTRIFUGAL PUMPS and PUMPING ENGINES specially adapted for Water-Works raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH-SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

ANDREW STEPHENSON, Agent.
Please address all communications to the Company, as above.

ANDREW STEPHENSON, Agent for BRIN'S OXYGEN COMPANY, Limited, Westminster, S.W.
City Address: 182, Gresham House, Old Broad Street, LONDON, E.C.

VOLCANIC Fire Cement (Winkelmann's)
Fire Resistance 4500° Fahr.
ANDREW STEPHENSON, Sole Agent, 182, Gresham House, Old Broad Street, LONDON, E.C.

CANNEL COAL, ETC.

JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

JOHN RILEY & SONS, Chemical Manu- facturers, Hapton, near Accrington, are MAKERS of SULPHURIC ACID, from Brimstone, for Sulphate of Ammonia making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol. References given to Gas Companies.

HUTCHINSON BROTHERS, Barnsley, Gas Engineers and Contractors, Makers of Wet and Dry Gas-Meters and General Gas Apparatus, Sulphate of Ammonia Plant, Lead Saturators, Tanks, &c., Tools and Sundries.

TUBES AND FITTINGS

FOR Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.
JOHN SPENCER, Globe Tube Works, WEDNESBURY, and 14, Great St. Thomas Apostle, LONDON.

TO GAS ENGINEERS AND MANAGERS.

R. ANDREWS, Retort Setter. Thirty years' practical experience. Retorts set on the Regenerative Principle or Ordinary Settings; Benches built; Repairs, &c.
Address 67, Sugden Road, Lavender Hill, LONDON, S.W.

WANTED, by a young married Man (abstainer), a SITUATION as WORKING MANAGER of Gas-Works, making about 10 millions. Has held present Colonial Management over three years, in which he has Engine, Exhauster, &c., under his charge. Could be disengaged in about Three Months.
Address No. 2141, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.
Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. IV., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock, Oldham."

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 70, Wellington Street, GLASGOW; 58, Fountain Street, MANCHESTER; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors, for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."

TO INVENTORS AND OTHERS.

PATENTS for Inventions Secured and TRADE MARKS REGISTERED throughout the World. Advice on all matters connected with the above. Handbook gratis on application.
J. C. CHAPMAN, C.E., Chartered Patent Agent, 70, Chancery Lane, LONDON.

BOROUGH OF IPSWICH.

MANAGER OF WATER-WORKS.

THE Corporation of Ipswich invite APPLICATIONS for the post of MANAGER of their Water-Works. The person appointed will be required to take entire charge of the Works, Pumping Station, and Reservoirs, design and carry out extensions of Mains and Plant, take Meters, and generally superintend the Water Supply of the Town under the directions of the Water-Works Committee.
The salary will be £150 a year, with House, Rates and Taxes, Coals, and Gas.
Applications, with not more than three recent testimonials as to fitness, to be sent in to the TOWN CLERK, Town Hall, IPSWICH, before the 8th of October, 1892.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application.
OXIDE PAINT, SULPHURIC ACID, & Chemicals.
120 and 121, NEWGATE STREET, LONDON, E.C.

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore.
Particulars and price, apply to Mr. T. L. ARCHER, Cathedral Chambers, Half Street, MANCHESTER.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

LIQUOR and Tar wanted.
BROTHERTON AND CO., Ammonia and Tar Distillers, LEEDS and WAKEFIELD.

OXIDE OF IRON. Genuine Natural Bog ORE. QUALITY AND CONDITION GUARANTEED. Any quantity supplied at lowest rates.
D. M. NELSON AND SONS, 68, Bath Street, GLASGOW. Telegraphic Address: "Gas, Glasgow." Depôts throughout England and Scotland.

FRIEDRICH LUX, Ludwigshafen am Rhein; and at No. 142, Great Portland Street, London, W.
LUX's Gas Regulators for every consumption.
LUX's single-stem Pressure-Gauges.
LUX's Regulator for Gas-Engines.
LUX's Gas-Balance.
LUX's new Gas Regulator for Inverted Lamps and other Apparatus for Gas Lighting, &c.

FITTER (Practical) wants a Situation.
Used to Gas Company's Works, Meters, Stoves' Indexing, and general routine of Outdoor Fitting Department.
Address W. HENRY, 5, Fairbank Street, East Road, CITY ROAD, E.C.

WANTED, for Brazil, Meter Repairer, used to Iron Wets. Wages, £18 per month first year, and £19 second year.
Apply, by letter, stating qualifications, to No. 2145, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a thorough Gas-Fitter, accustomed to inside and outside work, Main and Service laying, Indexing, and Smithing. Total abstainer preferred.
Applications, by letter only, stating age (28 to 40), previous employment, and Wages required, to be addressed to Mr. W. B. MIMMACK, Gas-Works, St. Mary Cray, KENT.

WANTED, for a Gas Company in Brazil, a first-rate GAS-FITTER AND METER REPAIRER. Engagement three years. Wages, £14 per month.
Apply, by letter, in own handwriting, stating age (not over 25), past and present employment, and if married or single, to No. 2144, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

STOKER required immediately, and to light and put out Public Lamps until May 1, 1893. Wages 25s. per week.
Apply to the SECRETARY, Gas-Works, Crawley, SUSSEX.

CLERK WANTED, in London. Must have technical knowledge of Gas Plant, Good Book-keeper, Correspondent, and have had experience of General Office Work.
State, by letter, last salary and full particulars, age, &c., to No. 2143, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

CIRENCESTER GAS COMPANY, LIMITED.

FOR SALE—Two 29 feet Hydraulic MAINS, RETORT-FITTINGS, one 4-horse-power Vertical ENGINE and PUMPS.
Further particulars from E. M. BEECHAM, Manager.

FOR SALE, cheap—72 Ornamental Iron STREET LAMP POSTS, 14 feet high, with Lanterns complete, suitable for Gas or Electric Light.
Address H. F. JOEL AND CO., 31, Wilson Street, FINSBURY, E.C.

FOR SALE—A perfectly new 20,000 cubic feet per hour EXHAUSTER, with Steam-Engine combined, including Hydraulic Gas Governor, Bye-Pass Valves, and Connections.
For further particulars, apply to Mr. T. G. MARSH, 41, Corporation Street, MANCHESTER.

SECOND-HAND PURIFIERS AND STATION METER FOR SALE.

TWO Purifiers, 5 ft. 6 in. by 3 ft. 6 in. each, cast in one piece, and in good condition; also STATION METER with 3-inch Connections, by Milne and Son, Edinburgh, constructed to pass 600 cubic feet per hour. All for sale owing to extension of Works.
Apply to the MANAGER, Gas-Works, Pitlochry, PERTHSHIRE, N.B.

FOR SALE—Second-Hand Gas Plant:
Two Wrought-Iron CHIMNEYS, 42 ft. long, tapering from 4 ft. to 3 ft. 6 in. by $\frac{5}{16}$ in. Plates.
22 Wrought-Iron HYDRAULIC MAINS, 16 ft. by 19 ft. by 9 ft. long, with Cast-Iron Covers, having Seven holes for Dip-Pipes.
154 ∩ MOUTHPIECES, Tangye's patent Lids, 20 in. by 16 in.
18 6 in. GAS-VALVES.
One Horizontal Tangyes' ENGINE, with EXHAUSTER combined, to pass 20,000 cubic feet per hour.
Also a lot of H-PIPES and ASCENSION and DIP PIPES.
For further particulars, apply either by letter, or personally, to Mr. B. W. SMITH, Engineer, Gas-Works, SMETHWICK.

GUILDFORD GASLIGHT AND COKE COMPANY.

THE Directors of the above Company are prepared to receive TENDERS for their surplus AMMONIACAL LIQUOR from this date to June 30, 1893.
Tenders to state a price per cask of 40 gallons of from 6° to 10°.
Coal Carbonized, 10,000 tons per year.
Tenders to be endorsed "Tender for Liquor," and to be sent to the Chairman of the Gas Company, Guildford, on or before Sept. 30 inst.
By order,
WILLIAM LONGWORTH,
Secretary.
Gas Offices, Guildford,
Sept. 24, 1892.

SALE OF GAS COKE AND COKE BREEZE AT THE ROYAL ARSENAL, WOOLWICH.

THE Secretary of State for War is pre- pared to receive TENDERS for the purchase of such quantities of GAS COKE and COKE BREEZE as may be for disposal during the period of One Year from the 1st of October, 1892, at the Royal Arsenal, Woolwich, where Forms of Tender and all Information may be obtained, on application to the Superintendent of Building Works.
Parties tendering will be at liberty to submit offers for either the Coke or the Breeze or for both, and are requested to make themselves acquainted with the mode of measurement at the Royal Gas Factory.
The Tenders are to be delivered at the War Office, Pall Mall, S.W., by Twelve o'clock Noon, on Wednesday, the 5th day of October, 1892, addressed to the Director of Army Contracts, and marked on the outside, "Tender for the Purchase of Coke and Breeze."
G. LAWSON,
Director of Army Contracts.
War Office, Pall Mall, S.W.,
Sept. 21, 1892.

CORPORATION OF LEICESTER.

SULPHURIC ACID.

THE Gas Committee of the above Corpo- ration are prepared to receive TENDERS for the supply of SULPHURIC ACID, made either from Native Sicilian Brimstone, Recovered Sulphur, or Pyrites. Specific Gravity in each case to be stated.
The price to include free delivery by Rail into elevated Tanks (27 feet high) at the Chemical Works, Aylestone Road Gas-Works.
Probable quantity, about 1200 tons, to be delivered as required during the ensuing Twelve Months.
Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Acid," to be delivered at these Offices not later than Eleven o'clock a.m., on Saturday, Oct. 8.
The Committee do not bind themselves to accept the lowest or any tender.
ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.
Gas Offices, Millstone Lane, Leicester,
Sept. 22, 1892.

LUDLOW UNION GAS COMPANY.

THE Company are prepared to receive TENDERS for the supply, during the period from the 17th of September, 1892, to the 30th of June, 1893, of from 1200 to 1500 tons of best screened GAS COAL, in quantities to suit the requirements of the Company.
Tenders to be forwarded to J. W. MONTFORD, Solicitor, Ludlow, SALOP.

TAR AND LIQUOR.

THE Eccleshill and Bolton Gas Company invite TENDERS for the surplus TAR and AMMONIACAL LIQUOR, to be produced at their Works, together or separately, for Twelve Months, from the 1st inst. Can be delivered in Contractor's Tanks at the Station (G.N.R.).
Coal carbonized per annum, about 1800 tons.
Tenders, sealed and endorsed, must reach me not later than Monday morning, the 3rd of October.
J. MELLOR,
Secretary.
Eccleshill, Bradford,
Sept. 23, 1892.

ROCHESTER, CHATHAM, AND STROOD GAS-LIGHT COMPANY.

SUPPLY OF COALS.

THE Directors of the above Company invite TENDERS for the supply of 30,100 tons of GAS COALS, to be delivered between the 1st of November next and the 31st of July, 1893.
Particulars and copy of Form of Tender and Contract may be had on application to
WILLIAM SYMS,
Secretary and Manager.
Gas Office: 58, High Street, Rochester,
Sept. 22, 1892.

COUNTY BOROUGH OF HALIFAX.

TO TAR DISTILLERS AND OTHERS.

THE Gas-Works Committee of the Halifax Corporation are prepared to receive TENDERS for the purchase of about 2500 tons of the surplus GAS TAR manufactured on the Premises, between the 1st of October, 1892, and the 1st of July, 1893.
Further information may be obtained on application to Mr. Thomas Holgate, Engineer, Gas-Works, Halifax.
Tenders, endorsed "Tender for Tar," must be sent to me on or before Thursday, the 29th of September, 1892.
By order,
KEIGHLEY WALTON,
Town Clerk.
Town Hall, Halifax,
Sept. 16, 1892.

TO CHEMICAL MANUFACTURERS.

THE Corporation of Birkenhead are prepared to receive TENDERS for the purchase of about 300 tons of SPENT OXIDE now lying at their Gas-Works.
Forms of Tender and Samples may be obtained from the Gas Engineer, Mr. T. O. Paterson, C.E., at the Gas-Works, Thomas Street.
Tenders, sealed, and endorsed "Tender for Spent Oxide," to be sent in to me not later than Five p.m. on Friday, the 7th of October, 1892.
The Corporation do not bind themselves to accept the highest or any tender.
By order,
ALFRED GILL,
Town Clerk.
Town Hall Birkenhead,
Sept. 24, 1892.

SALE OF NEWPORT (MON.) GAS SHARES UNDER THE PROVISIONS OF THE COMPANY'S ACT, 1886.

MR. RICHARD B. EVANS has received instructions from the Directors to SELL by PUBLIC AUCTION, at the King's Head Hotel, Newport, on Wednesday, the 12th day of October, 1892, at Three o'clock in the Afternoon punctually, 100 CLASS "C" SHARES OF £100, in Lots of One Share each.
The Statutory Dividend is 7 per cent. per annum.
Particulars and Conditions may be had on application to the AUCTIONEER, No. 30, Bridge Street, NEWPORT; or to Mr. EDWARD F. MARFLEET, Secretary, at the Offices of the Company, Newport, MON.
Dated Sept. 20, 1892.

CROYDON COMMERCIAL GAS AND COKE COMPANY.

SALE BY TENDER OF 500 ORDINARY £10 SHARES,

Being a portion of Additional Capital authorized to be raised under the powers of the Croydon Gas Act, 1877.
MINIMUM PRICE, £22 PER SHARE.

THE Directors give notice that they will be prepared to receive—not later than Eleven o'clock on the Morning of Wednesday, the 12th of October, 1892—sealed TENDERS for 500 ORDINARY £10 SHARES, to be paid up in full on or before the 31st of October, 1892, from which date Dividend will commence to accrue.
The last Dividend paid upon this class of Shares was at the rate of 11 per Cent. per Annum.
One Share, or any number of the 500 £10 Shares, may be tendered for, and the respective Share or Shares will be registered in the names of the purchasers, or their nominees, free of expense.
Printed Particulars and Conditions of Sale, and Form of Tender, can be obtained at the Offices of the Company, Katharine Street, Croydon.
WILLIAM J. RUSSELL,
Secretary.
Sept. 7, 1892.

SWANSEA, GLAMORGANSHIRE.

IMPORTANT SALE OF SWANSEA GAS SHARES.

JOHN M. LEEDER AND SON will offer for Sale BY PUBLIC AUCTION (pursuant to the provisions of the Swansea Gas Order, 1888), at the Mackworth Arms Hotel, Wind Street, Swansea, on Friday, Oct. 7, 1892, 500 NEW ORDINARY 7 per cent. SHARES 1888, of £25 each, in the Swansea Gaslight Company, being part of the Additional Capital the Company is authorized to raise by the Swansea Gas Order, 1888.
The Shares will be entitled to Dividend at the rate not exceeding 7 per cent. per annum, and will rank equally in respect thereof as part of the Original Capital of the Company. All the Lots will be sold with the right to Dividend accruing as from the 1st day of October, 1892. The Company have for many years paid full Maximum Dividends; and they have a large Reserve Fund, which is available for maintaining such Dividends.
Sale to commence at Half-Past Two o'Clock in the Afternoon.
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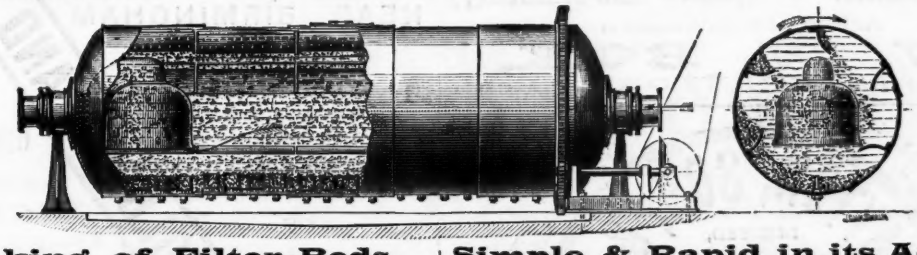

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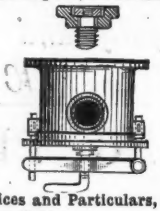

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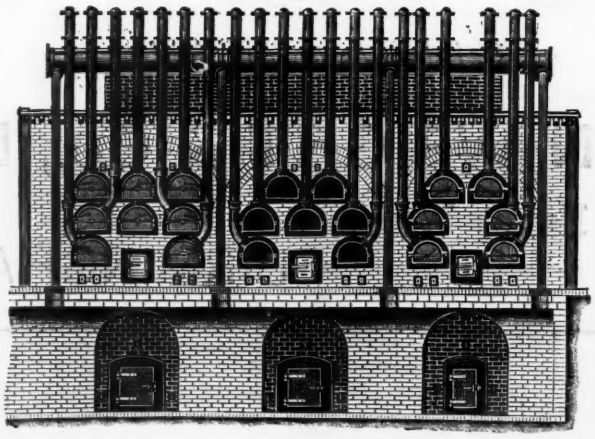

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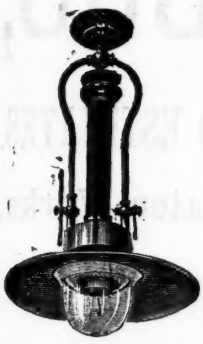

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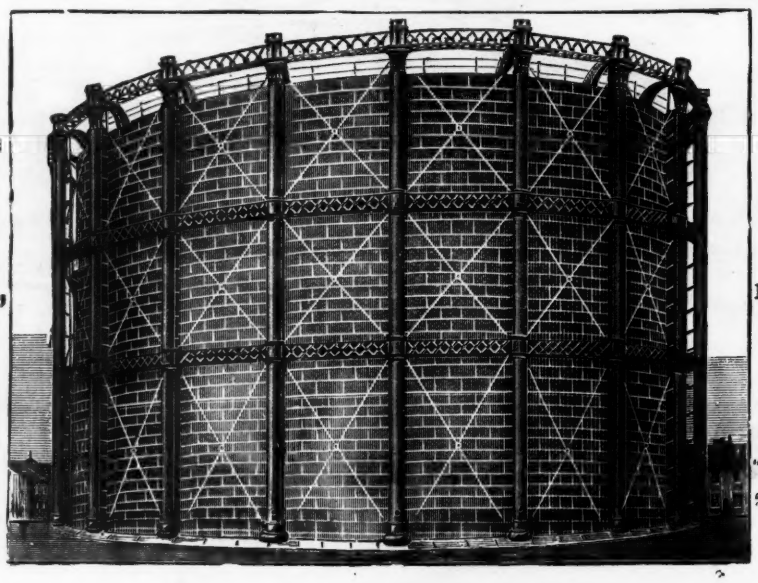

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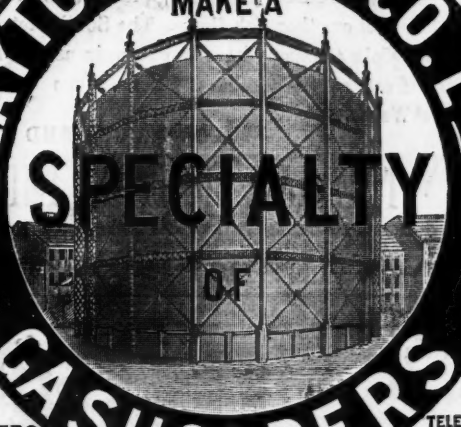

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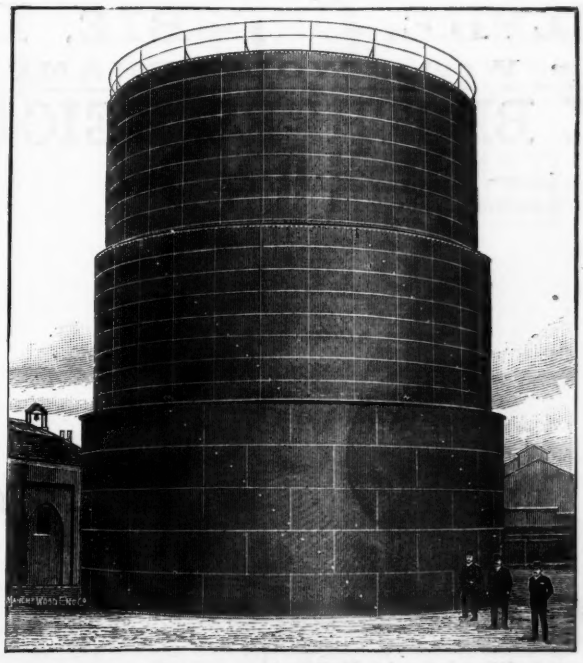

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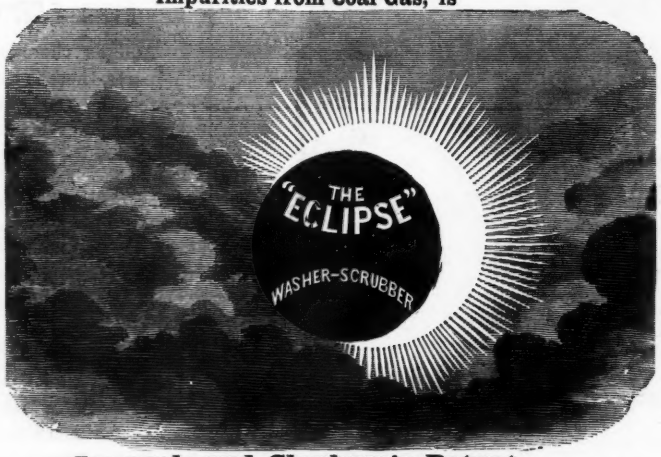

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